Policy Development Studies
Number 9

IMPACT OF RURAL DEVELOPMENT PROJECTS ON DEMOGRAPHIC BEHAVIOUR

United Nations Fund for Population Activities

11441

11441
CPHE-CLIC

Policy Development Studies
Number 9

IMPACT OF RURAL DEVELOPMENT PROJECTS ON DEMOGRAPHIC BEHAVIOUR

Edited by

Richard E. Bilsborrow
Pamela F. DeLargy

United Nations Fund for Population Activities

CPHE

COMMUNITY HEALTH CELL
LIBRARY
AND
INFORMATION
CENTRE

Statements made and views expressed in this publication are those of the authors and not of the United Nations Fund for Population Activities.

Copyright © 1985 United Nations Fund for Population Activities

DEM-100
11441 N85

FOREWORD

Although there is a wider recognition today that development plays a crucial role in population trends, few field studies on those relationships have been undertaken. The measures on the demographic effects of economic development projects are still being developed.

The five case studies presented in this volume make an attempt to study the effects of irrigation, rural electrification and colonization projects on population factors. The authors discuss the projects in terms of theoretical approaches, data collection procedures, analytical methods and policy implications. The final chapter considers methodological issues in assessing the population impact of rural development projects.

It is hoped that the publication of this report will create interest among scholars in undertaking further studies in the field.

Rafael M. Salas
Executive Director
United Nations Fund for
Population Activities

New York
January 1985

TABLE OF CONTENTS

Preface
List of Contributors

INTRODUCTION 1

Why Population-Development Research?
Importance for Resource Allocation
Background to the Case Studies
Notes
Appendix

RURAL ELECTRIFICATION, FERTILITY CHANGE, AND FAMILY PLANNING PRACTICE IN THE SOUTHERN PHILIPPINES: PRELIMINARY ANALYSIS: Alejandro N. Herrin and Amanda Te 7

Background to the Present Analysis
A Conceptual Framework
Research Strategy
Socioeconomic Profile of Sample Areas
Statistical Analysis
Summary and Conclusions
Notes
Appendix 1: Household Survey
Appendix 2: Community Survey
Appendix 3: List of Variables

THE EFFECTS OF ELECTRIFICATION AND THE EXTENSION OF EDUCATION ON THE RETENTION OF POPULATION IN RURAL AREAS OF COLOMBIA: Juan ter-Wengel 47

Methodological Framework
Data Collection and Description of Sample Populations
Electrification and the Extension of the School System: Effects on the Retention of Population
Conclusions

DEMOGRAPHIC IMPACTS OF RURAL DEVELOPMENT RELATED TO AN IRRIGATION PROJECT: Pramote Prasartkul, Thavisak Svetsreni, Chakratit Dhanagom and Anthony Pramualratana 65

The Development Project under Investigation
Theoretical Approach and Hypotheses
Data Collection
The Sample Villages

Empirical Results
Summary
Policy Implications
Notes

THE DEMOGRAPHIC IMPACTS OF THE CROSS RIVER PLANTATION PROJECTS IN NIGERIA: Joseph Uyanga 99

The Development of Plantation Agriculture in Nigeria
Characteristics of the Plantations
The Theoretical Model and Hypotheses
Data Collection Procedures
Data Analysis and Results
Conclusion
Notes

THE DEMOGRAPHIC DYNAMICS OF A FRONTIER AREA: THE STATE OF RONDONIA, BRAZIL: Maria Helena F.T. Henriques 133

Background
Data Collection: The Socio-demographic Survey
The Settlers as Migrants
Characteristics of Settlers
Demographic Effects
Final Remarks
Notes
Appendix: Questionnaire Content

METHODOLOGICAL ISSUES IN ASSESSING THE DEMOGRAPHIC EFFECTS OF RURAL DEVELOPMENT PROJECTS: Richard E. Bilsborrow and Pamela F. DeLargy 169

Summary and Comparison of Study Findings
Project Design: Problems Encountered and Lessons Learned
  Theoretical and Modelling Considerations
  Data Collection
  Analysis of Data
  Inferring Policy Implications from the Results
Postlogue
Notes
Appendix: Format for Report on Assessing the Demographic Impact of a Development Project

ADDENDUM: THE INTERNATIONAL CONSORTIUM FOR THE STUDY OF THE POPULATION IMPACT OF RURAL DEVELOPMENT PROJECTS: CONCEPTUAL EVOLUTION 201

PREFACE

The present monograph represents the collective efforts of university researchers, mainly in low-income countries, to develop preliminary guidelines for evaluating the effects of economic development projects. The investigators collected primary data at the household and community level to study the impact of irrigation, rural electrification, and colonization projects on fertility, mortality/morbidity, and internal migration. The institutions represented in the overall project are in Brazil, Colombia, Nigeria, the Philippines, and Thailand, with the Carolina Population Center serving as the co-ordinating institution.

While the presentation of findings from such case studies, based on original micro-level data, is interesting in itself, there is another, more unusual aspect underlying this volume. The five participating scholars also were brought together to exchange views and offer suggestions about each other's projects at both the proposal (pre-field-work) and analysis phases; a unique undertaking among developing country researchers. Many lessons were learned from this experiment about how to organize such an undertaking in order to achieve even better results in the future. Suggestions for similar co-operative arrangements are presented in the Addendum.

The umbrella programme which brought the five studies together, the International Consortium of Research Centers on Population and Development, was supported by the United Nations Fund for Population Activities (UNFPA) and the Rockefeller Foundation. The projects of the investigators from the five participating developing country institutions also were supported by either the Rockefeller Foundation or the UNFPA, with the Carolina Population Center of the University of North Carolina at Chapel Hill providing additional funding for administrative and data processing assistance. We are grateful to all these organizations for their assistance, as well as their continual encouragement to bring this volume to fruition (and their forebearance during its long gestation). What we learned about the logistical difficulties of international collaboration while developing this monograph could fill yet another volume. But when we were frustrated, we recalled the difficulties faced by the investigators "in the field" which helped us to put matters back into perspective. Our sincere thanks go to them for their hard work and dedication, as well as for their patience with our many requests for further information and clarification.

Various individuals have assisted in the Consortium activity, including J. R. Udry, Betty Cogswell, and Moye Freymann of UNC/CPC; A. Thavarajah, S. L. N. Rao, and L. Sherry-Cloonan of the UNFPA; Mary Kritz of the Rockefeller Foundation; and David Horlacher of the United Nations Population Division. William Dolbee, Candace Harrison, Karen Kurczewski, Priscilla Newby, and Kathy Ross typed the various drafts and we are grateful to them, as well as to Lynn Igoe for editorial assistance.

Chapel Hill,
North Carolina
December, 1984

Richard E. Bilsborrow
Pamela F. DeLargy

LIST OF CONTRIBUTORS

Richard E. Bilsborrow, Ph.D., in Economics, University of Michigan, is currently a Research Associate Professor in the Department of Biostatistics and a Fellow of the Carolina Population Center, University of North Carolina, Chapel Hill.

Pamela F. DeLargy, Ph.D. candidate in Political Science and M.P.H. candidate in Health Policy and Administration, University of North Carolina, Chapel Hill.

Chakratit Dhanagom, Institute for Population and Social Research, Mahidol University, Thailand.

Maria Helena F.T. Henriques, Instituto Brasileiro de Geografía e Estatística, Rio de Janeiro, Brazil.

Alejandro N. Herrin, Associate Professor and Deputy Director, School of Economics, University of the Philippines, Diliman, Quezon City, Philippines.

Anthony Pramualratana, Institute for Population and Social Research, Mahidol University, Thailand.

Pramote Prasartkul, Director, Institute for Population and Social Research, Mahidol University, Thailand.

Thavisak Svetsreni, Institute for Population and Social Research, Mahidol University, Thailand.

Amanda Te, Chairman, Department of Economics, Xavier University, Cagayan de Oro City, Philippines.

Juan ter-Wengel, Faculty of Interdisciplinary Studies, Javeriana University, Bogotá, Colombia.

Joseph Uyanga, Department of Geography and Regional Planning, University of Calabar, Nigeria.

INTRODUCTION

WHY POPULATION-DEVELOPMENT RESEARCH?

The past three decades have been marked by two dominant characteristics in the developing countries of the world: (1) an awakening of the need to achieve widespread economic development to improve the lot of the world's poor, and (2) a population explosion unprecedented in history. The former has involved national independence or decolonization movements in many low-income countries and a heightened concern about achieving greater economic progress. It has concerned governments of all political persuasions and many international agencies and has stimulated many of the world's best thinkers to become actively involved in seeking approaches to maximize economic growth and to improve the distribution of gains from such growth. And indeed, the absolute size of the economic pie in developing countries during this time period may well have increased at a rate unequalled in human history despite concerns about its distribution and inflation, recession, and foreign debt problems.

But many governments, international agencies, and scholars see mushrooming population growth as threatening these gains and even reversing improvements in the quality of life, especially among the poorest population groups. It is well known that increased population growth in low-income countries has resulted largely from modern health and sanitation practices which have helped reduce mortality drastically in a relatively short time period. The World Population Plan of Action (WPPA), developed at Bucharest in 1974, recognized the omnipresent interrelations between population growth and economic expansion and called for more data collection, research, and the explicit adoption of policies and programmes by developing countries to incorporate population in development planning.

IMPORTANCE FOR RESOURCE ALLOCATION

Developments since Bucharest, including the extent to which the WPPA has been implemented, were carefully reviewed at the August 1984 World Population Conference in Mexico City. One thing is clear, however; despite all the attention given to the incorporation of population in development planning at the country or macro level, there has been very little work at the micro or *project* level, specifically on measuring the "population impact" of specific economic development projects. The term "population impact" refers to the effect(s) of development projects or programmes *on* population. Its usage in this sense can be traced to McGreevey et al.[1] and McGreevey and Holmes.[2] The importance of evaluating such effects has been widely recognized and international aid organizations such as the World Bank and the U.S. Agency for International Development (USAID) are increasingly interested in the utility/feasibility of including an assessment of population impact as a standard part of the appraisal of development projects.[3] The need for work in this area is also recommended in Miro and Potter[4].

The lack of experience in measuring the population impact of development projects is surprising given the population concerns expressed by governments and the billions of dollars spent each year by developing countries and international organizations on development projects ranging from roads, dams, and other physical infrastructure, to human resource investments such as schools and health facilities, and directly productive investments such as mines, factories, and rural colonization schemes. Governments in developing countries have increasingly expressed interest in being better able to assess *a priori* the population effects of development projects, that is, the effects on fertility, mortality, and migration rates. For example, the final recommendation from the June 1984 National Seminar on Population and Development in Upper Volta, chaired by the Minister of Planning, was that there be "an evaluation of the demographic effect of every project having an impact on. . .fertility, mortality or migration."

A question addressed by this volume is: is it possible to develop procedures to measure the demographic effects of various types of economic development projects, and, if so, how? Clearly, if such procedures existed, they could be used to measure the effects in some concrete cases, which might provide information useful for estimating the probable demographic impact of certain types of development projects. But perhaps more important, if the procedures existed, one could build them into the economic development projects *a priori*, perhaps by conducting a baseline survey in the area prior to implementing the project and following it up some time later with a survey after the project was in operation. If one knew the demographic situation and behaviour of the population in the project impact area before and after the project, one would have information to develop a first approximation of the demographic effects of the project. Given the declared importance of achieving specific demographic goals in many developing countries, this might, in turn, influence decisions about what development projects to undertake, at least at the margin.

In actual fact, there has been very little experience in determining the demographic impacts of development projects and, moreover, almost all the existing attempts that have been published have been based not upon primary micro data but on secondary or macro information. For example, this is true of all the studies in the only published volume we are aware of devoted to this topic.[5] This limitation is recognized by many researchers. For example, in his study of the effects of irrigation in the Awash Valley of Ethiopia, Kloos uses very limited aggregate data and cites the "need for more information on who moves and on relevant characteristics of movers."[6] It is also important to compare the situation of people in project and similar non-project areas to assess project effects. As Barlow notes:

> Focussing their attention on the fertility effects of the original limited project in Comilla, Mueller and Anderson recognize that the detailed survey data needed for an accurate measurement of these effects do not exist. The ideal data set would include observations for both the Comilla locality and control localities for periods both before and after the development project. In the absence of the ideal data set—a not unusual situation—the authors use various pieces of indirect evidence. . .[7]

On the other hand, in those few cases where micro data *have* been used, they have usually been collected for some other purpose. For example, in his estimate of the expected future impact of the Mahaweli Ganga development project (irrigation, hydropower, and settlement) in Sri Lanka, Bauer[8] used national level 1975 World Fertility Survey data rather than data specifically on the project area population. Estimates derived from such data can only be very general at best and may, in fact, be spurious.

BACKGROUND TO THE CASE STUDIES

The present volume presents five case studies, each based upon original data collected at the household or community level, that at least in part measure the demographic effects of a specific development project. Some projects focused upon fertility, others on migration or mortality/morbidity. All were small-scale projects carried out with little or no government assistance, largely by university professors within the country. The case studies are presented not as models of population impact analysis, but as exploratory studies. Since there has been so little experience with this type of analysis, there are no "rules" as yet; the researchers had to experiment. The studies utilized different approaches for both data collection and analysis. Moreover, the development projects themselves were different—rural electrification in two countries, colonization programmes in another two, and irrigation in the fifth. Given the different methods, the different projects, and of course the considerable differences among the five countries, inferring generalizations either about the effects of the development input on population or about the most useful methodologies to use is risky at best, but we hope no more than foolhardy at worst. While we do attempt to piece together some recommendations concerning research methods in the concluding chapter, we cannot overemphasize their preliminary character. The present state of the art is not advanced enough to give encouragement to those who believe that specific population impacts of development projects can be identified and predicted with sufficient reliability so as to influence the allocation of resources for development projects. Indeed, this monograph represents little more than an initial plunge into a new and complex area.

The five projects presented as case studies were themselves part of an experiment—the research programme of the International Consortium of Research Centers for the Study of the Population Impact of Development Projects, begun in 1979 and designed as a forum for discussion and collaborative research concerning the population impact of development projects whose primary goals were *not* related to population. The Consortium consisted of six member institutions: The Carolina Population Center of the University of North Carolina; the Institute for Population and Social Research, University of Mahidol, Bangkok, Thailand; the Faculty of Interdisciplinary Studies, Javeriana University, Bogotá, Colombia; the Research Institute for Mindanao Culture, Xavier University, Cagayan de Oro, the Philippines; the Department of Geography, University of Calabar, Calabar, Nigeria; and the Department of Population Statistics (IBGE), Rio de Janeiro, Brazil (see Appendix I). The Carolina Population Center served as secretariat and headquarters for coordination and data analysis and put its administrative, library, information

retrieval, and data analysis facilities at the disposal of the other Consortium members. Each of the other five institutions was represented by a Principal Investigator who developed and conducted a study of the demographic impacts of a specific development project in his or her country. The present edited volume, describing the Consortium and including edited and revised final reports of the five projects, as well as methodological suggestions regarding this type of research, was suggested at the second consortium workshop held in Chapel Hill in June 1980.

The International Consortium was an experiment and its goals were ambitious. It was a novel approach to population impact research, providing a way for the developing country investigators to come together to share ideas, research methods, and findings. The cross-fertilization of ideas strengthened each individual project. There were also hopes that it could provide a basis for a more comprehensive model relating demographic behaviour to development. But this more ambitious goal could not be attained for a number of reasons relating in part to differences in type of development projects and in disciplinary training. Project differences resulted in part from the fact that the Consortium projects, rather than being designed together from the beginning, were selected from projects already approved (based on other criteria) by various funding organizations. Research designs had largely been decided upon and only marginal alterations could be made through membership in the Consortium. Nevertheless, the projects presented in this volume do illustrate how analyses based on survey data can help in the appraisal of the demographic impact of rural development projects. They thus provide a basis for discussion of the methods available for population impact research.

A more detailed description of the Consortium, its goals and activities, problems and successes, is presented in the Addendum to Chapter 7 of this volume. We hope it can provide some guidelines for future, similar collaboration, which we strongly encourage. A real value of this volume, in addition to furthering the development of population impact research, is the involvement of a group of well-qualified individuals and research institutions from developing countries who pooled their resources and expertise to examine a common, pressing, international problem, and thereby made the Consortium a genuinely collaborative arrangement.

NOTES

Chapter One

1. McGreevey, William G., et al., *The Policy Relevance of Recent Social Research on Fertility.* Occasional Monograph Series No. 2 (Washington, D.C.: Smithsonian Institution Interdisciplinary Communications Program, 1974).
2. McGreevey, William and David Holmes, "Population Impact of the Development Perspective, 1975-1980" (Washington, D.C.: The Smithsonian Institution, 1975).
3. King, Timothy, "Measuring the Demographic Consequences of Development Programs and Projects: A Background Note for the Bank Workshop, April 25-25." Paper written for a workshop sponsored by the Population and Human Resources Division, The World Bank (Washington, D.C.: April 24-25, 1979).
   Population and Human Resources Division, "Measuring the Demographic Impact of

Bank Projects." A report on a workshop sponsored by the World Bank (Washington, D.C.: The World Bank, April 24-25, 1979).
4. Miro, Carmen and Joseph Potter, *Population Policy: Research Priorities in the Developing World.* Report of the International Review Group of Social Science Research on Population and Development (London: Frances Pinter, 1980).
5. Barlow, Robin, ed., *Case Studies in the Demographic Impact of Asian Development Projects* (Ann Arbor, MI: Center for Research on Economic Development, University of Michigan, 1982).
6. Kloos, Helmut, "Farm Labor Migrations in the Awash Valley of Ethiopia." *International Migration Review,* v. 16, n. 1, 1982, pp. 133-168.
7. Barlow, Robin, *Case Studies.*
8. Bauer, John, "The Fertility Impact of the Mahaweli Ganga Development Project, Sri Lanka." In Barlow, *op. cit.,* 1982, pp. 101-143.

APPENDIX I

INTERNATIONAL POPULATION/DEVELOPMENT CONSORTIUM
Field Investigators

Dr. Maria Helena F. da Trinidade Henriques
Dept. de Estudos Geograficos
Rua Ecuador 558, 2° Andar
Instituto Brasilero de Geografía e Estatística
22.220 Rio de Janeiro, Brazil

Prof. Alejandro N. Herrin
Deputy Director, School of Economics
University of the Philippines
Diliman, Quezon City
The Philippines

Prof. Pramote Prasartkul
Director, Institute for Population and Social Sciences
Mahidol University
420/1 Rajvithi Road
Bangkok, 4, Thailand

Prof. Joseph Uyanga
Department of Geography
University of Calabar
P.M.B. 1115
Calabar, Nigeria

Prof. Juan ter Wengel
Faculty of Interdisciplinary Studies
Universidad Javeriana
Carrera 7a. No. 40-62
Bogotá, Colombia

RURAL ELECTRIFICATION, FERTILITY CHANGE, AND FAMILY PLANNING PRACTICE IN THE SOUTHERN PHILIPPINES: A PRELIMINARY ANALYSIS

Alejandro N. Herrin and Amanda Te[1]

Development programmes traditionally pursued for non-demographic objectives may nevertheless have important demographic consequences. Consideration of these demographic effects can provide additional criteria for the selection of development strategies, as well as guidelines for programme design and implementation. Of course, the current lack of explicit demographic intent in the formulation and implementation of development programmes results from the fact that socioeconomic welfare is a valid objective in itself. Yet another important reason may be the lack of a clear understanding by planners of the impact of such programmes on population variables, because of the complexity of population-development interactions as well as the inadequacy of relevant research.

In many less-developed countries rural areas are currently undergoing rapid demographic change, including fertility decline. Many have benefited from various rural development inputs, including family planning programmes. Comparing such areas with other areas which have not had such development inputs can provide an excellent quasi-laboratory or experimental situation for a systematic study of the effects of development on demographic change.

One such rural setting is in the province of Misamis Oriental in the Southern Philippines. Demographic data from an intensive vital rates measurement project in a rural segment of this province reveal a significant decline in fertility from 46 births per thousand in 1972 to slightly less than 30 in 1975. The data indicate that the decline was largely due to a drop in marital fertility, especially among women aged 25-39, rather than to changes in the proportions of women married or in the age structure.

A large-scale rural electrification project was implemented by the national government in this area in late 1971, about the time this data collection project began. The rapid decline in the birth rate was recorded as starting a year or so after a large segment of the rural area had started to receive electricity, suggesting that changes related to rural electrification might have contributed to the observed fertility decline. Earlier, exploratory studies on the impact of rural electrification in 1975 and in 1977 suggest that this important change in rural infrastructure generated in turn widespread social and economic changes (see below). In addition, demographic surveys conducted in 1976 and 1977 reveal widespread acceptance and practice of family planning by currently married women, particularly in the electrified areas.

Putting these sets of evidence together, led to the hypothesis that *the provision of rural electrification in the area, interacting with other rural development efforts, generated social and economic changes that created downward pressures on fertility; and further, that these pressures, together with the provision of modern family planning services, brought about the sharp decline in birth rates observed.*

The dynamics of rural development and fertility change in this rural area, however, required more systematic study. The research described in this chapter represents such an effort. The first section describes the background, funding and co-ordination of the research; it presents background information on the national rural electrification programme in general, and on the Misamis Oriental project in particular. The next two sections describe a conceptual framework for assessing the fertility impact of rural electrification and the research methodology of the study. Socioeconomic and demographic profiles of the study areas and sample households are then presented, followed by the statistical model, with partial empirical results. The last section provides a brief summary and conclusions.

BACKGROUND TO THE PRESENT ANALYSIS

Antecedents and Parallels

Prior to 1975, when the Research Institute for Mindanao Culture of Xavier University first embarked upon its own set of population impact studies, very little was known about the economic, demographic, and social impact of rural electrification either in the Philippines or elsewhere. In the Philippines, only one study was available.[2] This study described economic changes in two pilot electrification areas based on such indicators as new houses being built, number of electric appliances, number of electricity-dependent business enterprises and their number of employees, and the number of irrigated farms.

In 1977, the National Electrification Administration (NEA) conducted the first of a series of national surveys planned to measure socioeconomic changes that have occurred in the electric co-operative areas. A limited analysis of the first survey was published[3], and a second survey was fielded in 1980, the results of which have yet to be released. The NEA also funded studies of at least three rural electric co-operatives in 1977. These studies, as well as that of the first national survey, tend to describe socioeconomic differentials between electricity users and nonusers, with little thorough analysis of the impact of electricity on communities or households as such.

Paralleling the efforts of the NEA were those of the Research Institute for Mindanao Culture, Xavier University, which in 1975 began systematically to assess the economic, demographic and social impact of rural electrification in Misamis Oriental. The first phase of this effort was exploratory in nature, designed to obtain a wide-ranging view of the specific economic and social changes associated with the introduction of rural electrification in the area. In 1975, a three-month extensive exploratory study was conducted in what is known as the MORESCO I area. Among other things, the study was focused around the

following major questions: (1) what is the extent of coverage of the electric co-operative after four years of operation and who are the major users of electricity; (2) to what extent has the rural electric service been reaching the rural poor; and (3) how has electricity been used at home and in the community, and what are the effects of such use? The results of this study are described in Madigan, Herrin, and Mulcahy[4], Herrin[5], and Herrin[6].

In 1977 a follow-up study was conducted to identify the mechanisms by which rural electrification helped bring about changes at the community level in agricultural production, employment and incomes, and in health, education, and environmental-sanitation facilities and services. At the household level, the investigation focused on changes in household activities, including changes in household consumption and investment patterns, home production, labour use and fertility. An attempt was also made to identify other factors, including other developmental inputs, which may have interacted with rural electrification in bringing about economic and social changes. In addition, an attempt was made to assess the role of these factors in facilitating, modifying, or constraining the impact of rural electrification. The results of this study are described in Herrin and Madigan[7] and Herrin[8].

In November 1976, Herrin proposed an Association of Southeastern Asian Nations' (ASEAN) collaborative research project on the demographic impact of rural development, including a Philippine component on the fertility impact of rural electrifcation in Misamis Oriental, to be based on a survey of a larger number of households. The proposal was approved by the ASEAN heads of population programmes, but funding from UNFPA was delayed. In the meantime, a project of the Food and Agricultural Organization (FAO), entitled "Demographic Impact of Agricultural Policies" was being begun under Pan Yotopoulos of Stanford University, which involved collecting survey data on agricultural households in Misamis Oriental under the direction of Herrin.

In 1979 the Rockefeller Foundation provided a grant to the Research Institute at Xavier University to study the fertility impact of rural electrification. This grant was used to survey additional households, to resurvey of households interviewed under the FAO component in order to obtain additional information, and to conduct a community survey of the sample villages. It also supported the analysis of the combined sets of data, partially reported herein.[9]

The National Rural and Provincial Electrification Programmes

The rural electrification programme is a major infrastructure programme of the Philippine Government aimed at improving the quality of life of the majority who are poor in the rural areas. The goal is to attain total electrification of the country by 1990. The national programme officially began in 1962 with the creation of the Electrification Administration, but funding limitations hampered the development of the programme until the passage of the National Electrification Administration Act in 1969. This act created the National Electrification Administration (NEA) and declared the national policy objective of total electrification of the country, with electric co-operatives as the primary medium for programme implementation. Under an area coverage concept, rural

electrification was to be provided by large power plants, each serving five to ten municipalities including all the rural villages (*barangays*) on a 24-hour basis.[10] In 1971 two pilot rural electrification projects were established in Misamis Oriental Province. Their success paved the way for the subsequent establishment of electric co-operatives throughout the country.

The NEA was converted to a public corporation in 1973, receiving additional powers and funding. The NEA has made significant progress in the development of physical facilities and establishment of electric co-operatives throught the country. As of July, 1981, the NEA reported that a total of 107 electric co-operatives were receiving electricity. These co-operatives served 1,585,210 households in 1,204 municipalities and 12,325 villages throughout the country, representing 30 per cent of the total potential households in the covered areas.

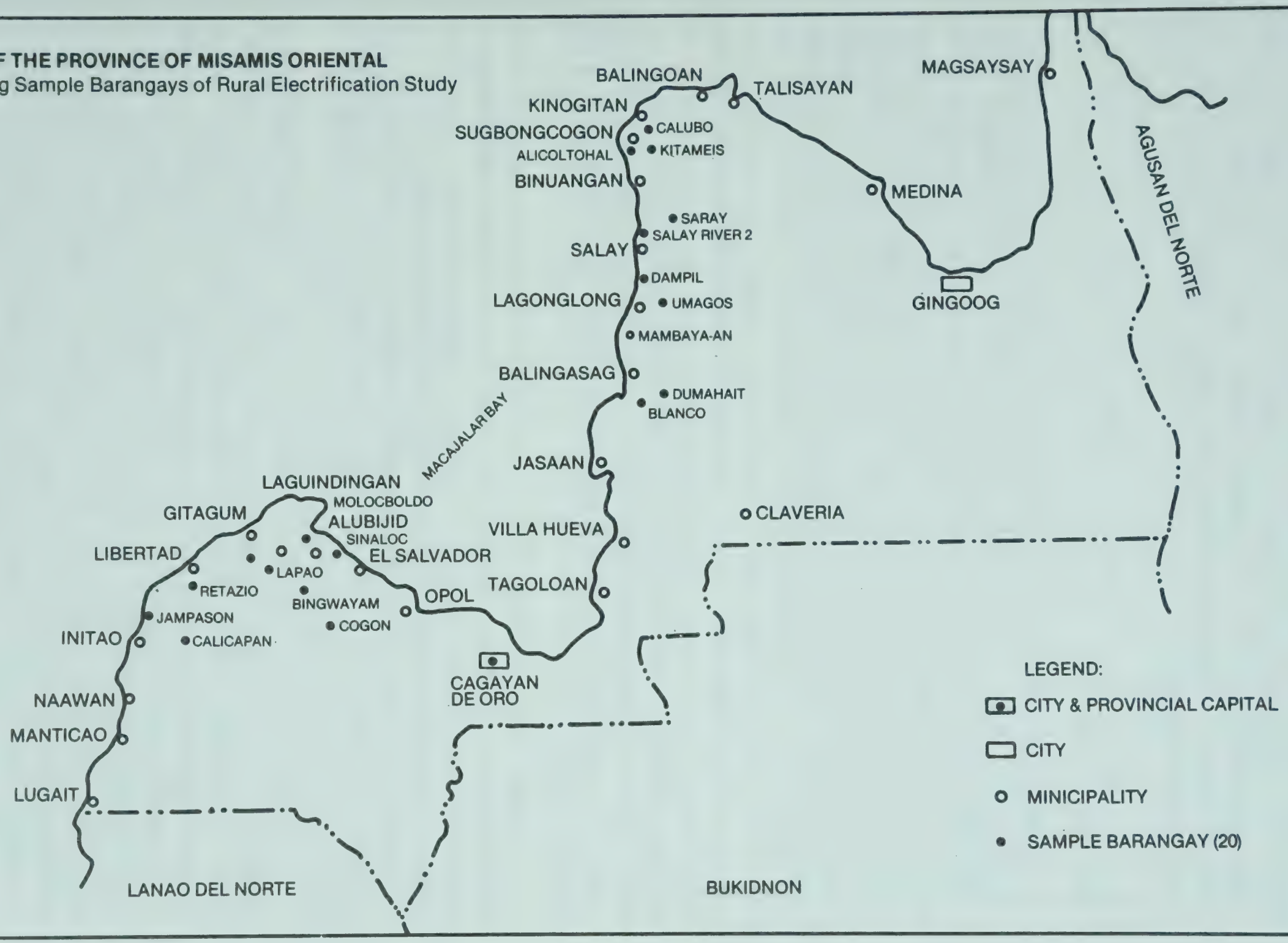
Misamis Oriental Province lies along the northern coast of Mindanao Island, the second largest island of the Philippine archipelago (see map pg. 11) The province comprises 24 municipalities and two chartered cities and had a 1975 census population of 560,490 living in a 3,570 square kilometre area. A rural electrification project was first implemented in late 1971 in the ten municipalities located west of the provincial capital, Cayagan de Oro, through the Misamis Oriental Rural Electric Service Cooperative (MORESCO I). In 1975 these municipalities had a population of 124,510 people, or about one-fifth of the provincial total. As of July, 1981, MORESCO I was serving 12,404 households in 118 villages of the ten municipalities, representing about half of the rural population. In addition, the co-operative was supplying electricity to business enterprises, irrigation systems, water systems, and public buildings and facilities, including educational institutions and health units.

The eastern segment of the province, comprising 14 municipalities (excluding Gingog City),[11] had a population of 222,474 in 1975, representing 35 per cent of the provincial population. In June, 1978, a second electric co-operative (MORESCO II) was established to serve these 14 municipalities and Gingog City. As of July 1981, a total of 12,038 households in 136 villages were provided with electricity, representing 30 per cent of the rural population.

A Socioeconomic Profile of Misamis Oriental[12]

The provincial economy is still basically argicultural, with more than half (56 per cent) of the population ten years old and over engaged in farming and related activities in 1975. Major crops are coconuts, corn, rice, vegetables, tobacco, and sorghum; about 62 per cent of the agricultural land is planted with coconuts, 23 per cent with corn, 4 per cent with rice, and the rest with vegetables, bananas, other fruit and crops. In addition to crop cultivation,marine fishing is a major source of livelihood for people in the coastal areas. With the exception of a pineapple canning factory and a few sawmills in Cagayan de Oro and a copra (dried coconut meat) processing firm in the east, there was no large-scale industrial or manufacturing activity in the province prior to the 1970s. In 1975, fifty-six per cent of the industrial establishments were located in Cagayan de Oro and Gingog.

MAP OF THE PROVINCE OF MISAMIS ORIENTAL
Showing Sample Barangays of Rural Electrification Study



Educational facilities include primary, intermediate, and secondary schools, which are mostly public, and colleges and and universities, which are mostly private. Primary and intermediate schools are available in the *barangays,* while secondary schools are found only in the municipal *poblacions.* Medical and health facilities are heavily concentrated in the cities. Rural areas are mainly served by rural health units, located in each of the 24 municipalities. These units are ordinarily staffed by a doctor, a nurse, one or two midwives, and a sanitary inspector. Traditional health attendants, mostly local midwives, are found in all *barangays.*

Development Trends

Comparable and up-to-date provincial level social and economic indicators are difficult to find, so one cannot readily compare Misamis Oriental with the rest of the over 70 Philippine provinces. Nevertheless, general impressions suggest that it was close to average in socioeconomic conditions among coastal regions in the country. Since the 1970s, however, it has been among the fastest growing provinces. Its development can be better documented from the perspective of its region—the northern Mindanao region. This region comprises seven provinces with a 1980 preliminary census population of 2.7 million. It has been one of the fastest growing regions in terms of population size, growing at an average annual intercensal rate of 4.1 per cent during 1960-70 and 3.5 per cent in 1970-80.[13] Some of this high growth resulted from net in-migration to the region rather than natural increase and has been accompanied by substantial rural-urban migration within the province. Though northern Mindanao has experienced faster economic growth than other regions, its mean income is still below average.

Prospects for the region's future development depend on the pace of implementation of the regional development plan. The northern Mindanao region, according to the 1978-82 plan, is to become a major industrial region in the southern Philippines, having the advantages of hydroelectric power (the source of electricity), strategic location, available agricultural lands and raw materials, and abundant forest and mineral resources. Cagayan de Oro is expected to become the financial and commercial center of the region.

In connection with national development efforts, Misamis Oriental implemented a number of social and economic development programmes in the 1970s. In agriculture, there has been establishment of farmer co-operatives, extension programmes, price supports and input subsidies, and technical assistance and credit facilities. In industry, major objectives have been to develop labour-intensive enterprises, increase net foreign exchange earnings, exploit natural resources, and disperse industry. Notable changes in the 1970s included the emergence of agri-based or natural resource-based, export-oriented enterprises, including a sorghum processing enterprise, three chemical plants, and several large food processing plants. In addition, a 3,000 hectare industrial estate was developed where an iron smelting plant has been in operation since 1976. Expected to locate in this estate are various other medium and heavy industries, including an integrated steel plant.

In the area of health and sanitation, the provincial government implemented several programmes to expand and improve rural health facilities, including the construction of small emergency hospitals (5-10 bed capacities) in some municipalities. In addition, a vigorous campaign for the construction of sanitary facilities was conducted and strong support was given to municipal and *barangay* governments in the construction of potable water supply systems.

In 1970 the Philippine Population Program was launched. Family planning educational and motivational activities, as well as provision of contraceptive supplies and services, were first implemented in the province through the rural health units. In 1977 the Commission on Population's Outreach Project was launched nationwide, calling for an expansion of family planning activities. Full-time outreach workers were trained and fielded to cover all *barangays* by providing information, supplies and services. Barangay Contraceptive Supply Points (BCSP) were set up to insure a continuous supply of contraceptives.

Another major development effort was the improvement of infrastructure. This included building farm-to-market roads, constructing a concrete highway connecting the capitals of two adjacent provinces and traversing the entire length of Misamis Oriental, expanding port facilities (both sea and air), building or improving public buildings and facilities, and, of course, rural electrification.

A CONCEPTUAL FRAMEWORK

The detailed information obtained from the exploratory studies, described earlier, provided the basis for conceptualizing the impact of rural electrification in the context of the overall development efforts in the province. This conceptual framework is consistent with a more general framework described below.

A General Framework

In a very general sense, the household or other microunit is viewed as essentially responsive to a set of opportunities and constraints, within the larger sociocultural context. The economic and social environment of households includes: (1) the prevailing structure of markets for factors and products; and (2) the prevailing social structure and organization which defines, for example, land tenure and crop sharing arrangements, patterns of family and nonfamily labour use and compensation, and social, economic, and political alliances which influence co-operative behaviour and community involvement. This environment is constantly subject to shocks through either (1) autonomous changes, such as in international prices for agricultural export crops, national price trends, technological changes, etc., or (2) rural development interventions. Such interventions include: (1) the provision of physical infrastructure (road, irrigation, electrification, etc.); (2) the provision of social infrastructure and services, including health, education, nutrition, environmental sanitation, and family planning; (3) agricultural programmes (land reform, development of co-operatives, provision of extension services, rural credit, and various input subsidies and price supports); and (4) industrial development programmes (tax and other incentives, credit, direct subsidies, etc.).

Either source of change (autonomous shock or government intervention) is expected to affect the structure of opportunities and constraints facing the household and other microunits, which are then expected to respond and adjust in a manner they perceive will improve their present economic and social position, or at least prevent it from deteriorating. Depending on the nature of the emerging structure of new opportunities and constraints, one may expect a *multiphasic response*[15] from these decision-making units in terms of economic, social, and demographic adjustments.

A Specific Framework

Within the context of the general framework above, a more specific framework for analyzing the relationship between economic, social and fertility change resulting from rural electrification and other development inputs can be described, with the aid of Figure 1. Rural electrification, interacting with the other development inputs, generates investments in electricity use, which in turn affect economic and social factors, and ultimate fertility. Note that the impact of rural electrification on a particular household (or other microunit) may arise not only directly through its own use of electricity but also indirectly through the use of electricity by other households and by the community as a whole. The specific mechanisms involved are outlined below.

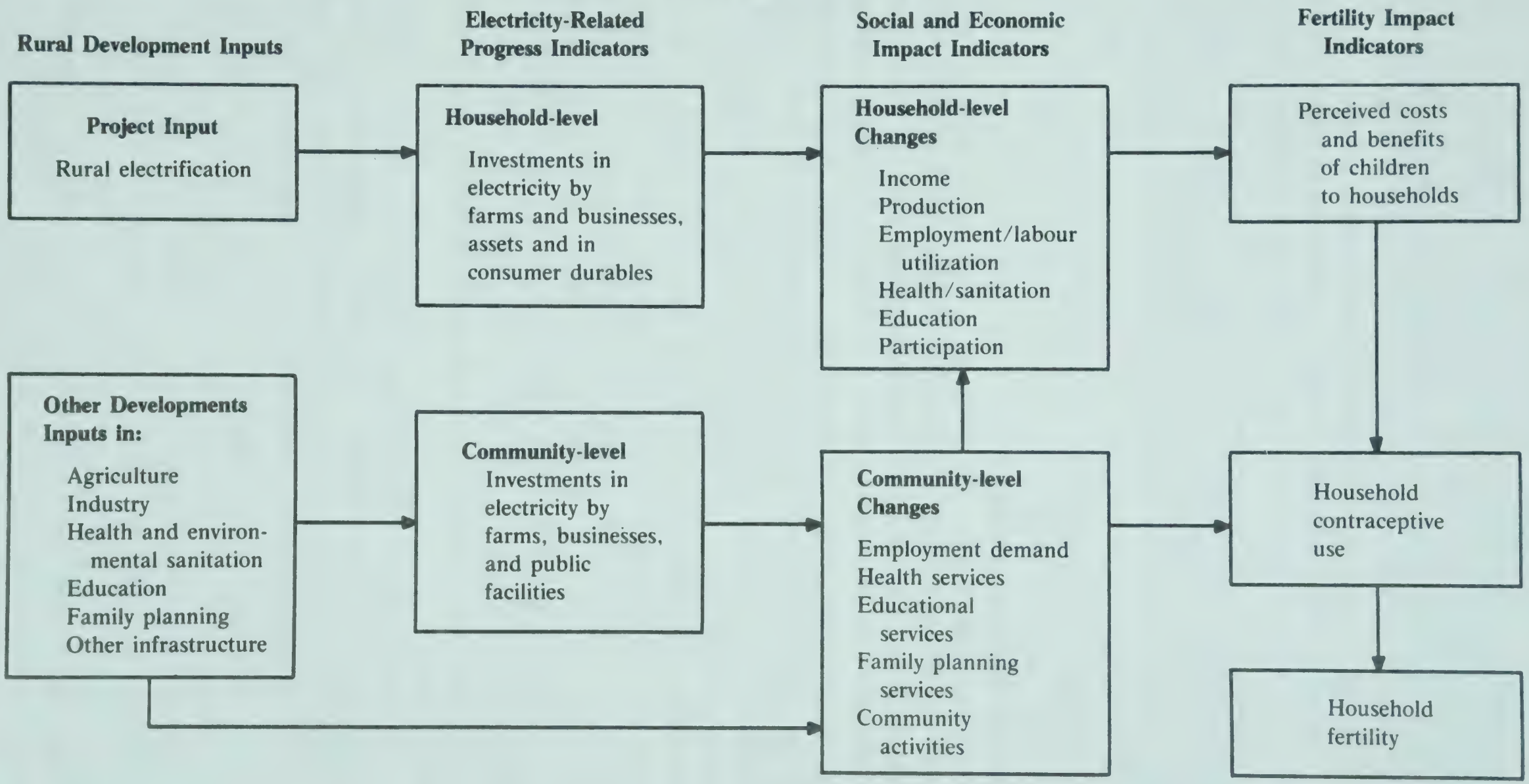
Income, Production, and Employment. It is hypothesized that rural electrification will affect total household income through: (1) increased agricultural production/productivity generated by household or public investments in electricity-dependent irrigation systems; (2) increased business or trade income/productivity generated by household investments in electricity-dependent machinery, tools, and appliances; (3) increased food production/productivity from livestock, poultry, and backyard gardening activities generated by household or public investments in electricity-dependent water supply systems; and (4) increased home production/productivity generated by household investments in electric lighting and electric durable goods. It can also be expected that electrification would increase paid employment of household members, including women, by generating new job opportunities created by electricity-dependent business enterprises.

Health, Nutrition, and Sanitation. Rural electrification is expected to affect health, nutrition, and environmental sanitation indirectly through its effect on income and food production, and through: (1) the increased availability of adequate and safe water generated by households and public investments in electricity-dependent water supply systems; and (2) the increased availability of, and improvements in, health and medical services generated by investments in electricity-dependent facilities.

Education. Rural electrification is expected to increase enrolment rates and improve the quality of education indirectly through its effects on household income. It should also lead to: (1) the expansion of educational services generated by the possibility of conducting night classes; and (2) the improvement in the quality of instruction through the use of electricity-dependent tools, appliances, and teaching aids. In addition, the proper illumination afforded by electric

Figure 1

CONCEPTUAL FRAMEWORK FOR ANALYZING THE FERTILITY IMPACT OF RURAL ELECTRIFICATION IN THE CONTEXT OF OTHER RURAL DEVELOPMENT INTERVENTIONS



lighting in the homes is expected to improve class preparation by teachers and to encourage and facilitate reading and homework completion by students.

Participation. Rural electrification may encourage greater participation of household members in community and social activities, through facilitating community and social activities that otherwise could not be conveniently conducted at night, and also by freeing household members from time-consuming chores.[16] The latter is expected to be brought about by household use of electric appliances and access to electricity-dependent water supply systems.

Fertility. Rural electrification is hypothesized to affect current fertility decisions, on the one hand, through its effect on changing income, employment, and investment and consumption opportunities (including health and education of children), thus increasing the opportunity costs of children; and on the other hand, through its effect on improving family planning services in the health units.

RESEARCH STRATEGY

Overall Research Design

The main hypothesis of the study is that rural electrification significantly contributes to changes in the socioeconomic and fertility behaviour of rural households. Three major types of evidence are usually required for testing hypotheses about causal relationships: (1) evidence of concomitant variation, (2) evidence of the time order of occurrence, and (3) evidence ruling out other possible causal factors.[17] The first set of evidence requires that X (the assumed causal, explanatory, or independent variable) and Y (the assumed effect or dependent variable) are associated in the way predicted by the hypothesis, for example, that Y should appear in more cases where X is present than in cases where X is absent. The second set of evidence requires, at minimum, that Y did not occur before X. Finally the third set of ideal evidence requires that there be no differences between the control and study groups except for the independent variable. If true, we can reject every hypothesis explaining the differences in the dependent variable except that pertaining to the variable under consideration.

Theoretically, the classical experimental design is a first choice in evaluative research. A principal feature is the random assignment of study units to experimental and control groups. This ensures that there are no preexisting differences between the two groups prior to the exposure of the experimental group to the "treatment" (here meaning the development project), other than those that would be expected due to chance alone. However, the implementation of this ideal design is rarely feasible in practice. As in the present case, the rural development programme to be studied was already underway or was soon implemented in the control areas. As a result, the third set of evidence on random assignment of areas,[18] is the most difficult to obtain. Sometimes, alternative quasi-experimental designs can be set up to approximate the ideal experimental situation and thus minimize selection bias. However, time and budgetary limitations often constrain implementation of such designs. In the case of this particular research, for example, a before-after design was not possible given

the short-term commitment of funding agencies. Although a longitudinal research strategy was kept in mind in the overall design of this project, the design that was feasible, given the above constraints, can be characterized as a nonexperimental, with-without design. Thus efforts to minimize the potential selection bias inherent in such a design, through appropriate sampling and multivariate statistical techniques, constituted an important component of this research.

Selection of Study Areas

The research design called for the selection of study areas to include those that were electrified and those that were not. Since no prior randomization was possible, the latter group is merely a comparison group rather than a control group in the strict experimental sense. Thus, the ten municipalities west of Cagayan de Oro covered by MORESCO I represented the electrified areas. These areas have had electricity since 1971. The 14 municipalities east of Cagayan de Oro now covered by MORESCO II represented the nonelectrified areas. These areas have been electrified only since June, 1978. Since field work in all areas was conducted from January through September, 1979, the basic with-without character of the study design obtains. The eastern areas are thus considered nonelectrified for analytical purposes.

The study areas were further restricted to include only six contiguous municipalities each in MORESCO I and MORESCO II areas, to minimize the travel cost of field operations. Each restricted segment of the province was further subdivided into approximately homogeneous substrata to reflect possible community-level variations in socioeconomic characteristics and access to development inputs. Ideally, *barangays* should be stratified in each segment according to physical, economic, and demographic characteristics, and level of development based on several indicators including presence of educational and health facilities, road access, agricultural output, etc. Unfortunately, such indicators were not available prior to the survey. A close approximation to the division of each segment into homogeneous strata, however, can be made by initially dividing *barangays* in each segment into geographic substrata, namely (1) the municipal *poblacion,* (2) rural coastal *barangays,* and (3) rural inland *barangays.* In Misamis Oriental, this division reflects differential development characteristics including crops cultivated, other economic activities, distance to markets, and access to basic social and other services. Because of funding delays, samples from only the latter two substrata were available for analysis here. *Barangays* in each of these two substrata were chosen purposely in such a way that the western *barangays* approximately match the eastern *barangays* in terms of physical location, size of population, and type of economic activity. This matching relied heavily upon the investigator's and the project staff's knowledge of specific areas obtained from their prior survey experience in Misamis Oriental since 1971. Detailed community-level data, however, were obtained as part of the project to test the assumption of homogeneity of the eastern and western *barangays* in terms of major social and economic characteristics.

Ten rural *barangays,* four coastal and six inland, were finally chosen from both the western and the eastern areas. In each sample *barangay,* 40 households were drawn by systemic sampling from a household list prepared earlier by the research team. The number of households averaged 159 in Eastern Misamis (ranging from 93 to 345) and 162 (ranging from 74 to 287) in Western Misamis.

Data Collection and Processing

Two sets of data were collected: (1) household data, incorporating a retrospective fertility survey of eligible women in the household, a management survey of agricultural and nonfarm production operations, and an income and expenditures survey; and (2) community-level data on social, economic, and demographic characteristics, and on various developmental indicators. The data sets are described more fully in Appendices 1 and 2.

The household survey was divided into two sets of interviews, one for the wife and the other for the husband. The interviewers recruited were residents of the sample villages where they were to conduct interviews. Hence, only one interviewer was assigned to do all the interviews in his village. Although some interviewers had worked with the Research Institute in earlier surveys, most were new recruits. A team of experienced personnel at the Research Institute trained and supervised the interviewers.

The use of resident interviewers proved to be advantageous and contributed to good rapport between respondents and interviewers. In view of the large set of questions to be asked each respondent, more than one interview session was often required. The proximity of the interviewers to their respondents and their being personally known to the respondents made appointments for additional interview sessions easy. In addition, travel costs of interviewers were minimized.

Field supervisors from the central office edited the completed forms in the field, checking for missing information prior to submission to the central office. A team at the central office edited the forms for inconsistent information preparatory to coding. Coding was conducted at the Research Institute by a group of coders trained earlier by the study team. The data were coded in as much detail as possible (with minimal aggregation or computations by the coders) to minimize additional sources of error and to allow greater flexibility in the construction of variables later in the analysis.

Computer editing, consistency checks, and analysis were performed later at the School of Economics, University of the Philippines. Data processing was hindered by the lack of programmers at the time the analysis was to be conducted and this was a problem throughout the analysis. Computer facilities at the University of the Philippines could not handle large packages—for example the Statistical Package for the Social Sciences (SPSS)—until May 1982. Therefore, the research team had to rely on commercial computer facilities, which was not only quite expensive but also inconvenient in terms of travel time. Thus the planned analysis has taken much longer than expected and only limited results can be presented at the time of preparing this report.

SOCIOECONOMIC PROFILE OF SAMPLE AREAS AND SAMPLE HOUSEHOLDS

Socioeconomic Profile of the Study Areas

This subsection describes the economic and social characteristics of the study areas based on the data obtained from the community survey. The motivation for obtaining community-level data was to determine some of the specific economic and social contexts within which the impact of rural electrification occurs. In addition, it is used to test for potential selection bias in comparisons to be made among electrified and nonelectrified areas. The main respondent was the *barangay* captain,[19] who generally is the single most knowledgeable person in the community.

Locational Indicators. The access of households to economic and social opportunities depends not only on opportunities at the village level but also those at the municipal and provincial levels. Hence, one set of indicators for such access is the distance of the villages to their own municipal centres *(poblacions)*, the distance to the national highway which connects them to other municipalities, including Cagayan de Oro, and the distance to Cagayan de Oro itself. The indicators by various substrata are shown in Table 1 below.

The western Misamis sample areas, although closer to Cagayan de Oro, tend to be farther from either their own municipal *poblaciones* or from the national highway than are the sample areas in eastern Misamis. Hence, the eastern *barangays* tend to have slight locational advantages with respect to more local opportunities, but the western *barangays* tend to have a locational advantage with respect to the capital city itself. In both areas, the availability of transport facilities and frequency of trips from the *barangay* to the municipal *poblacion* varied directly with distance.

Educational Services. In the community survey, information was sought on the types of schools located in the *barangay,* or if not in the *barangay,* the nearest schools and their distance. Table 1 summarizes such information for the two areas. Most *barangays* have elementary schools, but only 60 per cent have intermediate schools. Secondary schools are available in almost all *poblacions.* Residents send their children to the nearest secondary school, whether in their own *poblacion* or an adjacent one.

Table 1 reveals that primary and intermediate schools are available within two kilometres from all *barangays.* The distance to the nearest secondary schools, on the other hand, varies by distance to the municipal *poblacions* where the schools are located. The eastern *barangays* are closer to secondary schools, but the western Misamis *barangays* are closer to Cagayan de Oro, where colleges and universities are located.

Health and Environmental Sanitation. Table 2 presents selected health, family planning and environmental sanitation indicators. The first set of indicators measures distances to the nearest health facility. Several *barangays* have Barangay Health Stations (BHS), often manned by a midwife. In western Misamis only two *barangays* reportedly did not have a health station. In eastern Misamis, four *barangays* did not have a BHS, although a rural health unit, manned by a nurse, a midwife, a sanitary inspector, and a roving doctor, was available.

Table 1

MEAN DISTANCE OF BARANGAYS FROM MUNICIPAL POBLACION, NATIONAL HIGHWAY AND CAGAYAN DE ORO CITY, AND ACCESS TO EDUCATIONAL INSTITUTIONS, MISAMIS ORIENTAL SAMPLE, 1979

Indicator[1]	Western Misamis	Eastern Misamis
Distances		
Mean distance from municipal *poblacion* (km)	4.0 (1.8-8.0)	2.9 (1.0-6.0)
Mean distance from the national highway (km)	2.5 (0.0-8.0)	1.6 (0.0-6.0)
Mean distance from Cagayan de Oro (km)[2]	35 (21-60)	59 (48-74)
Mean roundtrip fare to/from Cagayan de Oro from hwy.	5.15 (3.00-10.00)	9.16 (7.00-12.00)
Schools		
Number with primary school in *barangay*	8	9
Number with intermediate school in *barangay*	5	7
Number with secondary school in own *poblacion*	10	8
Mean distance to nearest primary school (km)[3]	0.30 (0.0-2.0)	0.15 (0.0-1.0)
Mean distance to nearest intermediate school (km)[3]	0.92 (0.0-2.0)	0.68 (0.0-2.5)
Mean distance to nearest secondary school (km)[3]	4.02 (1.25-8.0)	2.57 (1.0-5.0)

[1]Ranges are in parentheses
[2]In pesos (7.7 = 1 U.S. dollar in 1979).
[3]A school located within the barangay was assigned a distance of zero.

Table 2

SELECTED INDICATORS OF HEALTH, FAMILY PLANNING, AND ENVIRONMENTAL SANITATION BY SUBSTRATA, MISAMIS ORIENTAL SAMPLE, 1979

Indicator[1]	Western Misamis	Eastern Misamis
Distance to nearest Rural Health Unit (km)	4.1 (1.8-8.0)	2.9 (1.0-6.0)
Distance to nearest *Barangay* Health Station (km)	0.72 (0-2)	1.5 (0-6)
Distance to nearest *Barangay* Supply Point (for contraceptives) (km)	2.95 (0-8)	1.62 (0-6)
Distance to nearest municipal hospital (km)	11.6 (0-23)	13.8 (3.5-25)
Index of access to health personnel[2]		
—all personnel	442 (61-992)	420 (61-838)
—all doctor/nurse/midwife	264 (14-469)	258 (24-730)
—nutritionist/home management technician	59 (4-365)	24 (0-58)
—sanitary inspector	22 (1-104)	18 (0-52)
—family planning motivator	97 (6-365)	122 (0-365)
Mean percent of households with water-sealed toilets	55 (0-100)	78 (20-100)

[1]Ranges are in parentheses
[2]Expressed as man-days per year spent by the type of person in the *barangay*.

Family planning clinics, like rural health units, tend to be located in *poblacions.* In addition, while the goal of the Population Commission's (POPCOM) outreach project was to establish a *barangay* supply point (BSP) for contraceptives in each *barangay,* only three *barangays* in the western sample and five in the eastern sample reported having one. The nearest pharmacy is usually located in the *poblacion,* although some *barangays* have a village drugstore called *biotica sa baryo.* In addition to the city and provincial hospitals located in Cagayan de Oro, there are small emergency or community hospitals of from 5-15 bed capacities in some municipal *poblacions,* two each in or near the western and eastern sample areas.

With this information, one can observe that distances to health facilities, such as the rural health units, family planning clinics, BSPs, and pharmacies, tend to follow relative distances to the municipal *poblacion.* The western Misamis sample areas, however, are closer not only to municipal hospitals but also to Cagayan de Oro, where large hospitals are located.

In addition to the distance measures, indexes of health personnel availability were constructed on the basis of the presence or absence of seven key health personnel: a medical doctor, nurse, midwife, nutritionist, home management technician, sanitary inspector and family planning motivator. The frequency of visits of these personnel were obtained from informants if they were not resident in the area. Residents were given a score of 365 person-days, those visiting once a month were given 12 person-days per year, and so forth. Personnel who do not make visits were given a score of zero person-days. The data obtained from the key informants showed great variability across *barangays* in terms of frequency of visits. The indexes do not reveal major differences between East and West.

The third set of indicators are related to environmental sanitation, i.e., water supply systems and type of toilet. Most *barangays* have communal water supply systems. In the western sample, six of the ten have electric water supply systems in addition to mechanical pump systems. Rural electrification has led to the construction of water supply systems in the western segment, either to replace or modify the existing system or to supplement the old systems. On the other hand, higher percentages of households in the eastern sample have inferior water-sealed toilets. Their prevalence and use are influenced by not only availability of water in the *barangay* but the actual distance of the house from the *barangay* water source.

Economic Activities. Table 3 summarizes data obtained from key informants on the economic activities of the area. These indicators include the percentages of households engaged in various activities, the percentages of area cultivated in major crops, and the index of access to modern technology and economic institutions through the frequency of visits by extension workers from government agencies.

Households in inland areas in both western and eastern Misamis are engaged largely in farm activities, with small percentages in other occupations such as trade. In the coastal areas, about a third of household heads in both segments are engaged in fishing and larger proportions are engaged in other activities besides farming.

Table 3

INDICATORS OF ECONOMIC ACTIVITIES, MISAMIS ORIENTAL SAMPLE, 1979

Indicator[1]	Western Misamis	Eastern Misamis
Per cent of HH in farm activities[2]	87	72
Per cent of HH in fishing activities[2]	14	19
Per cent of HH in other activities	10	9
Per cent of area cultivated in major crops:		
Coconut	77	80
Corn	48	18
Rice	2	9
Tobacco	35	0
Index of exposure to extension/ development personnel (man-days/year)	266 (37-747)	83 (7-118)
Number of agencies represented	6 (4-9)	7 (2-10)

[1]Numbers in parentheses are ranges for the values.
[2]The percentages may exceed 100 since households may be engaged in more than one type of activity.

To determine the extent to which development efforts were reaching the rural households, an index representing their exposure to extension workers was constructed by multiplying each type of extension worker by the number of times he visits the area in one year. Table 3 shows that areas in the western segment reported more visits per year than in eastern areas by a factor of three. The number of agencies making visits is about the same, but the number of visits appeared more frequent in the West. Agencies represented include crop-related agricultural, irrigation, social service, and community development bureaus. This may result from the closer distance of the western areas to Cagayan de Oro, where the offices of the extension workers are found.

The major sources of modern farm inputs in all these areas were agricultural stores located in either the local *poblacion* or Cagayan de Oro. Enterprises located in the *poblacion* were the major buyers of agricultural products, in addition to buyers who came to the *barangays.* As expected, there were few commercial establishments in the *barangays,* and these are mostly *sari-sari* (small general merchandise) stores, and occasionally a rice and corn mill. Purchases of agricultural machinery and agro-chemicals are made in Cagayan de Oro City.

Village Organization and Development Activities. An index of social activities in the villages is the number of active farm and social organizations and the frequency with which they meet. The number varied from three to nine in the eastern villages and from two to eight in the western villages. The most common organizations include the *Samahang Nayon,* a farm co-operative, set up in all villages under the agrarian reform programme. Parent-teacher associations, fishermen's associations, youth organizations *(Kubataang Barangay)* mothers' clubs, and various types of religious associations also exist.

A summary index was constructed by multiplying the number of times meetings are held per year for each active organization and summing across organizations. The mean value of the index for *barangays* in the West was 72, while it was 83 in the East, indicating that little differences exist on the average. However, index values varied widely among *barangays* within each of the two strata.

Another set of indicators measured the degree of development activities. Information was sought on the frequency of *barangay* council meetings, *barangay*-sponsored activities, and development projects completed, on-going or planned. Each *barangay* has a council headed by the captain, which meets once a month to discuss local activities, plans and problems. All *barangays* reported sponsoring weekly benefit dances, the proceeds of which go into a fund to finance local projects. In addition, most reported sponsoring basketball games once a week, and in several cases, a basketball tournament at least once a year.

On-going or recently completed development projects reported included the construction of water supply systems, roads, improvements and repairs in schools, and construction of a *barangay* state and community health centre. While these projects often receive financing from higher level governments, many of these local infrastructural activities do require local inputs as well in terms of contributions of money and labour.

Socioeconomic, Demographic, and Family Planning Profiles of Households

The Sample. Among the 800 households surveyed, there were 605 married women aged 15-49 years: 309 in the West and 296 in the East. For demographic analysis, the sample was restricted to women: (1) once married, aged 15-49 years, currently living with their husbands; (2) ever pregnant or currently pregnant; *and* (3) still regularly menstruating. The last two restrictions were made to insure that only fecund women were included in the analysis. These restrictions reduced the final sample to 468 women; 259 in the West and 209 in the East. Unless otherwise stated, all subsequent descriptions of socioeconomic, demographic, and family planning characteristics refer to this sample (for example, Tables 4 and 5).

Table 4

SELECTED SOCIOECONOMIC INDICATORS, MISAMIS ORIENTAL SAMPLE, 1979

Indicator	Western Misamis	Eastern Misamis
Sample Households	259	209
Mean Level of Education (years)		
Husband	4.8	5.7
Wife	5.3	5.8
Per cent with High School or More[1]		
Husband	18.2	29.6
Wife	21.1	29.3
Per cent in Husband's Occupation		
Farmer	81.5	80.9
Fisherman	13.5	12.0
Others	5.0	7.2
Per cent of Women Working for Pay or Profit	20.5	33.0
Per cent of Households Constructed with:		
Light Materials	72.2	73.7
Mixed or Heavy Materials	27.8	26.3
Per cent of Households with Electric Connection	31.3	2.4

[1]Percentage with at least one year of high school.

Table 5

SELECTED DEMOGRAPHIC AND FAMILY PLANNING INDICATORS, CURRENTLY MARRIED WOMEN, MISAMIS ORIENTAL SAMPLE, 1979

Indicator	Western Misamis	Eastern Misamis
No. of Women	259	209
Mean Age of Woman[1]	33.3	36.4
Mean Age at Marriage[1]	19.7	20.3
Mean Duration of Marriage[1]	13.6	16.1
Mean No. of Children Ever Born	5.27	6.61
Mean Household Size	6.5	7.2
Percentage of Women:		
Know a FP Clinic	98.0	96.6
Ever Visited a FP Clinic	60.9	52.7
Ever Visited by FP Personnel	33.1	34.5
Ever Used a FP Method	57.5	50.1
First Method Used:		
Modern	37.1	23.0
Others	20.4	27.2
Current Use of FP Method	43.2	36.9
Current Method Used:		
Modern	28.2	14.4
Others	15.0	22.5

NOTE: FP = Family Planning.

1 = Expressed in years

Education. Compared to women in the rural Philippines as a whole, the Misamis Oriental sample women appeared to have a higher level of education. The mean years of highest grade completed was 5.1 for Philippine rural women (based on the 1978 Republic of the Philippines Fertility Survey), while the level was 5.5 for the sample. Within the sample, eastern women tend to have higher levels of education (5.8 versus 5.3 years). The same pattern emerges when educational level is measured as the percentage of women with at least one year of high school.

Economic Activities of Women. In both regions, rural women often work as unpaid labourers in family economic activities. A significant percentage, however, work either for pay or profit, mainly as school teachers or as petty traders. The data shown in Table 4 reveal higher percentages of women working in the East.

Housing Characteristics. The type of construction material often reflects the economic status of the household. As can be expected, a large proportion of rural households lived in houses constructed of light materials, with little difference observed between East and West. In the West, where the rural electrification project has been in operation much longer, about 30 per cent of the households had electric connections in 1979, versus 2 per cent in the East.

Age of Women. Data on age reveal that women in the eastern sample are older than those in the West (36.4 years in the East compared to 33.3 years in the West).

Age at Marriage. The mean age at marriage was higher among women in the East than in the West: 20.3 versus 19.7 years. These are both higher than the Philippines mean age at marriage for rural women, which was 19.1 years based on the 1978 Republic of the Philippines Survey.

Children Ever Born. Data on children ever born reveal a higher mean number among eastern than western women: 6.61 versus 5.27. This differential partly reflected the fact that eastern women are older and had been married longer. The mean duration of marriage among eastern women was 16.1 years, compared to 13.6 years for western women.

Awareness of Source of Knowledge about Contraception. Awareness of modern family planning methods in the sample was uniformly high (95 per cent or more), as is true for the national population. The least known (10 to 30 per cent) are the traditional or folk methods. The level of awareness of modern methods can be attributed largely to the efforts of the family planning programme, especially family planning motivators. These personnel, together with doctors, nurses, and midwives in public and private health units, were reported by respondents as the main sources of information on modern family planning methods. The major source of information regarding traditional methods, on the other hand, were relatives and friends.

A very large majority of the women (95 per cent and above) in each area and substrata know of the location of the family planning clinic. However, only about half of the eastern women and 61 per cent of the western women reported ever having visited a family planning clinic. When asked whether they themselves were ever visited by a family planning motivator, only a third answered affirmatively.

Family Planning Practice. The percentages of women who reported current use of family planning were 43 in the West and 37 in the East. The percentages *ever* practicing family planning were 58 and 51, respectively, about the same as the national average rural rate of 51.1 reported in the 1978 Republic of the Philippines Survey.

Contraceptive Methods. The data on contraceptives methods first used are shown in Table 5. Modern contraceptive methods were defined to include only the pill, IUD, and sterilization. The data reveal that modern contraceptive use is greater in the West than the East, with traditional methods used more in the East.

STATISTICAL ANALYSIS

Selection Bias.

Given the nonexperimental nature of the study design, the problem of selection bias was an important consideration in the impact analysis. The first task of the statistical analysis was therefore to test for selection bias. If such bias were significant, it would have to be controlled for in the impact assessment in order to obtain valid inferences.

This test consisted of examining by regression analysis whether the sample electrified areas differ systematically from the nonelectrified areas in basic background characteristics. On the basis of earlier results on community and household characteristics and the sampling scheme adopted by the study, area and household-level selectivity bias can be tested by an equation of the form $AE = f(A)$, where AE is a dummy variable indicating whether the sample area was electrified ($= 1$) or not ($= 0$), and A represents a set of area-level characteristics (see Appendix 3). If there were no selection bias between areas or households, then we would expect the coefficients of the A variables to be statistically insignificant.

The results showed that, except for the distance to the provincial capital variable, none of the variables was significant. When this one variable is omitted, the overall regression equation became insignificant. This result suggests that, had the supply of electricity been equally available to all the sample areas, east and west, then both the currently electrified and the nonelectrified sample areas would have had the same prior probability of being electrified on the basis of selected background characteristics. This further suggests that the careful purposive sampling procedure adopted by the study was appropriate *ex post* in terms of minimizing potential area selection bias. A simple random sample of areas would not have guaranteed such results. On the other hand, more complex stratified sampling or matching procedures were not feasible at the time, in view of the limited prior information regarding the socioeconomic and physical characteristics of the communities under consideration.

Main Results

Impact on Intermediate Variables. As indicated in the conceptual framework presented earlier, rural electrification is expected to influence cur-

rent fertility and family planning decisions indirectly; on the one hand, through its effects on income, employment, and investment and consumption opportunities (including health and education of children), and, on the other hand, through its effect on family planning services in the health units. A set of regression equations could be developed to determine whether electrification variables do in fact contribute to variations in these intermediate variables. The predicted values of these intermediate variables could then be entered into the current fertility or family planning equations. Unfortunately, this type of analysis could not be implemented at the present stage since the intermediate variables had not yet been processed into the form necessary for such an analysis. However this analysis is planned in the near future, including the testing of a simultaneous equations model, once programming and data processing constraints are relaxed.

Impact on Fertility and Family Planning. To examine the relationship between rural electrification and a set of fertility and family variables, the following regression equations were tested:

(1) LB5 = f(IW, H, A, FP, AE, HE)
(2) LB 2 = f(IW, H, A, FP, AE, HE)
(3) WAC = f(IW, H, A, FP, AE, HE)
(4) FPU = f(IW, H, A, FP, AE, HE)
(5) MFPU = f(IW, H, A, FP, AE, HE)

where

LB5 = number of live births during the last five years to currently married women;
LB2 = dummy variable indicating whether the woman had a live birth during the past two years (if had, = 1; if not, = 0);
WAC = a dummy variable indicating whether the woman desires additional children;
FPU = a dummy variable indicating whether the woman is currently practicing any family planning methods;
MFPU = a dummy variable indicating whether the woman is currently practicing modern family planning methods (defined as pill, IUD, or sterilization);
IW = a set of individual characteristics of the woman, including her past fertility (parity);
A = a set of areal characteristics;
FP = a set of family planning access variables;
AE = a dummy variable indicating whether the *barangay* in which the dwelling is located had electricity; and
HE = a dummy variable indicating whether the dwelling itself had electricity.

In equations (1) through (5), only individual and household background characteristics not directly influenced by rural electrification are included as independent variables in order to avoid simultaneity bias. The explanatory variables of interest, of course, are the two electrification variables, AE and HE. A significant coefficient for AE would suggest that the presence of electricity in the community has a relationship with the dependent variables above

and beyond effects arising from the presence of electricity in the household itself. A significant coefficient for HE would suggest that the presence of electricity in the household has a significant effect on the dependent variable.

Two alternative measures of current fertility were used as dependent variables, namely, the number of live births during the past five years (LB5) and a dummy variable indicating whether the woman has had a live birth during the past two years (LB2). Additional sampling restrictions were made to insure that only women married five years or longer were included in the LB5 equation, and only women married two years or longer in the LB2 equation. The results of the regression analysis are shown in Tables 6 and 7.

With respect to the regression on live births to women over the past five years, the results show (regression number 2) that the coefficient of the presence of electricity in the household (HELEC) is negative and significant for the all-women sample. This suggests that women in the electrified households had lower current fertility than those in nonelectrified households. The coefficient for the presence of electricity in the area (AELEC), however, was not significant, although it had the correct sign. Significant coefficients are also obtained for the age of the woman (AGEW) and the distances from the *poblacion* (DISTOB) and Cagayan de Oro (DISTCGYO), all of which have the correct signs.

The coefficient for the index of exposure to family planning motivators (FPINDEX) is also significant but positive, indicating that women whose area is visited more often by family planning personnel tend to have *higher* current births than those whose areas are less often visited. It is possible that simultaneity bias exists, in the sense that family planning personnel tend to concentrate their visits to areas known to have higher fertility. Note also that the variable does not necessarily represent the individual woman's own contact with family planning workers.

Table 7 shows the results where the dependent variable is measured as whether the woman has had a live birth during the previous two years. The household electrification variable (HELEC) is again highly significant; while the area electrification variable is not. Except for age and the distance to *poblacion* variable (DISTOB), the other independent variables are all significant.

Impact on Fertility Desires. Fertility preference was defined in terms of whether the woman wanted any more children, beyond those she had at the time of interview. Table 8 shows the results. Besides the expected results for age and parity, no other variable was significant except household electrification, and that only when area electrification was not included.[20]

Impact on Family Planning Practice. Table 9 shows the results on current practice of family planning methods by currently married women in Misamis Oriental. In contrast to the results above, here the area electrification variable (AELEC) is positive and significant as hypothesized, although household electrification is not. The results also suggest that women currently using a family planning method tend to be younger, of higher parity, and of higher education, each of which is consistent with expectations. In addition, women in coastal areas, who live further away from the city, and whose husbands are farmers are more likely to be users. The family planning index is again significant but of the opposite sign, consistent with the view that family planning personnel

Table 6

REGRESSION ON THE NUMBER OF LIVE BIRTHS THE WOMEN HAD IN THE PAST FIVE YEARS, MISAMIS ORIENTAL SAMPLE, 1979

Independent Variables	(1)	(2)	Mean	Std. Dev.
AGEW	-0.074***	-0.075***	36.398	7.078
	(-8.724)	(-8.702)		
CSD74	0.084	0.083	0.570	0.496
	(0.714)	(0.704)		
EDW	0.011	0.010	5.711	2.249
	(0.493)	(0.456)		
OCCH	-0.111	-0.109	0.803	0.398
	(-0.857)	(-0.841)		
HOUSE	0.020	0.022	0.719	0.450
	(0.176)	(0.197)		
COASTAL	-0.009	-0.012	0.435	0.496
	(-0.084)	(-0.105)		
DISTPOB	0.044*	0.045*	3.500	1.948
	(1.669)	(1.685)		
DISTCGY	0.007**	0.006	45.813	16.125
	(2.070)	(1.415)		
DISTFPC	-0.001	-0.001	12.054	25.005
	(-0.348)	(-0.385)		
FPINDEX	0.001**	0.001**	101.278	145.744
	(2.572)	(2.542)		
HELEC	-0.395***	-0.386***	0.199	0.399
	(-2.989)	(-2.817)		
AELEC	—	-0.037	0.550	0.498
		(-0.255)		
Constant	3.434	3.492		
R^2	0.256	0.254		
F	13.392	12.252		
n	402	402		
Mean	1.216	1.216		
Std. Dev.	1.067	1.067		

*Significant at the .1 level
**Significant at the .05 level
***Significant at the .01 level

(t-values are in parentheses)

Table 7

REGRESSION ON WHETHER THE WOMEN HAD A LIVE BIRTH IN THE PAST TWO YEARS, MISAMIS ORIENTAL SAMPLE, 1979

Independent Variables	(1)	(2)	Mean	Std. Dev.
AGEW	-0.025***	-0.026***	34.950	7.881
	(-7.520)	(-7.490)		
CSD74	0.036	0.035	0.618	0.486
	(0.657)	(0.644)		
EDW	0.002	0.002	5.879	2.279
	(0.167)	(0.197)		
OCCH	-0.019	-0.018	0.811	0.392
	(-0.318)	(-0.310)		
HOUSE	-0.039	-0.038	0.724	0.448
	(-0.760)	(-0.740)		
COASTAL	-0.018	-0.019	0.436	0.496
	(-0.365)	(-0.389)		
DISTPOB	0.026**	0.026**	3.542	1.936
	(2.137)	(2.145)		
DISTCGY	0.002	0.002	45.726	15.823
	(1.566)	(1.031)		
DISTFPC	0.0003	0.0002	12.059	24.776
	(0.298)	(0.251)		
FPINDEX	0.0001	0.0001	103.533	146.918
	(0.880)	(0.850)		
HELEC	-0.206***	-0.202***	0.186	0.390
	(-3.378)	(-3.210)		
AELEC	—	-0.016	0.548	0.498
		(-0.253)		
Constant	1.247	1.274		
R^2	0.212	0.210		
F	11.982	10.966		
n	456	456		
Mean	0.454	0.454		
Std. Dev.	0.498	0.498		

*Significant at the .1 level
**Significant at the .05 level
***Significant at the .01 level

(t-values are in parentheses)

Table 8

REGRESSION ON WHETHER THE WOMEN WANTED NO MORE CHILDREN, MISAMIS ORIENTAL SAMPLE, 1979

Independent Variables	(1)	(2)	Mean	Std. Dev.
AGEW	-0.015***	-0.015***	35.147	7.953
	(-5.614)	(-5.636)		
CSD74	0.296***	0.296***	0.691	0.462
	(6.734)	(6.718)		
EDW	-0.006	-0.005	5.884	2.343
	(-0.767)	(-0.697)		
OCCH	-0.049	-0.050	0.812	0.391
	(-1.039)	(-1.059)		
HOUSE	-0.029	-0.031	0.715	0.452
	(-0.726)	(-0.767)		
COASTAL	-0.035	-0.037	0.432	0.496
	(-0.890)	(-0.937)		
DISTPOB	-0.008	-0.009	3.568	1.958
	(-0.881)	(-0.971)		
DISTCGY	-0.002*	-0.002	45.397	15.874
	(-1.851)	(-0.069)		
DISTFPC	0.001	0.001	12.083	24.798
	(1.432)	(1.498)		
FPINDEX	0.00005	0.0006	105.986	148.498
	(0.458)	(0.515)		
HELEC	-0.0004**	-0.011	0.197	0.398
	(-0.084)	(-0.211)		
AELEC	—	-0.028	0.561	0.497
		(-0.543)		
Constant	0.265	0.222		
R^2	0.299	0.298		
F	17.143	15.711		
n	421[a]	421[a]		
Mean	0.789	0.789		
Std. Dev.	0.409	0.409		

*Significant at the .1 level
**Significant at the .05 level
***Significant at the .01 level

(t-values are in parentheses)

[a]Sample excludes currently pregnant women.

Table 9

REGRESSION ON WHETHER THE WOMEN ARE CURRENTLY USING A FAMILY PLANNING METHOD, MISAMIS ORIENTAL SAMPLE, 1979

Independent Variables	(1)	(2)	Mean	Std. Dev.
AGEW	-0.018***	0.017***	35.147	7.953
	(-4.901)	(-4.725)		
CSD74	0.145**	0.144**	0.691	0.462
	(2.376)	(2.352)		
EDW	0.023**	0.025**	5.884	2.343
	(2.177)	(2.371)		
OCCH	0.115*	0.110*	0.812	0.391
	(1.759)	(1.692)		
HOUSE	-0.053	-0.061	0.715	0.452
	(-0.941)	(-1.084)		
COASTAL	0.114**	0.123**	0.432	0.496
	(2.091)	(2.251)		
DISTPOB	0.015	0.010	3.568	1.958
	(1.116)	(0.750)		
DISTCGY	0.002	-0.004**	45.397	15.874
	(1.422)	(2.205)		
DISTFPC	-0.001	-0.0004	12.083	24.798
	(-0.652)	(-0.375)		
FPINDEX	-0.0004**	-0.0003**	105.986	148.498
	(-2.163)	(-1.965)		
HELEC	0.075	0.045	0.197	0.398
	(1.125)	(0.646)		
AELEC	—	0.124*	0.561	0.497
		(1.732)		
Constant	0.572	0.382		
R^2	0.076	0.080		
F	4.026	3.958		
n	421[a]	421		
Mean	0.423	0.423		
Std. Dev.	0.495	0.495		

*Significant at the .1 level
**Significant at the .05 level
***Significant at the .01 level

(t-values are in parentheses)

[a]Sample excludes currently pregnant women.

concentrate efforts in areas where current practice of family planning is still low.

The results for women using *modern* family planning methods are shown in Table 10. Both electrification variables are now significant and have the correct signs, i.e., women in the electrified area *and* women in electrified households (each taking into account the other via the regression procedure) tend to use modern family planning methods (pill, IUD, and sterilization) more than women in households where electricity is not available or where the *barangay* does not have electricity.

It is instructive here to consider the mechanism by which electrification in an area may lead to greater use of modern family planning methods. The rural health clinics were among the first establishments to obtain electric connections when electricity came to an area. Interviews with the heads of these clinics in 1975 and 1977 revealed that with electricity they not only had better lighting for providing services in the daytime but also could perform services at night. Moreover, they could now perform additional services since they had electric sterilizers, could store vaccines and medications in a refrigerator, and had special bright lamps desirable for IUD insertions, etc. Thus, electrification affects the quality and quantity (the supply) of family planning services available.

Summary

It thus appears from the preliminary regression analyses that rural electrification is associated with lower current fertility and higher current use of family planning. The presence of electricity in the community appears to have a significant independent positive effect on the practice of family planning (especially the use of modern methods), after controlling for other locational variables which might affect the supply of family planning services. It is possible that the importance of family planning may be more recognized by women in areas where socioeconomic opportunities other than continued childbearing are more clearly perceived. The electrification of an area, a significant change in the rural setting which many residents never dreamed possible, may be the impetus to rural residents to consider such alternatives. Increased practice of family planning is then one of the possible responses to such a psychological change.

The stage is set for a more detailed examination of what it is about rural electrification in the community, and of the presence of electric connections in the home, that influences the demographic behaviour of these rural women. In other words, the stage is set for the testing of the specific mechanisms (hypotheses) presented earlier in the conceptual framework. This will be the subject of continuing investigation.

SUMMARY AND CONCLUSIONS

This chapter examined the fertility and family planning practice impact of rural development associated with the provision of a large-scale rural electrification project in Misamis Oriental Province, Philippines. Essentially, the

Table 10

REGRESSION ON WHETHER THE WOMEN ARE CURRENTLY USING A MODERN FAMILY PLANNING METHODS, MISAMIS ORIENTAL SAMPLE, 1979

Independent Variables	(1)	(2)	Mean	Std. Dev.
AGEW	-0.014***	-0.013***	35.147	7.953
	(-4.364)	(-4.044)		
CSD74	0.137**	0.134**	0.691	0.462
	(2.577)	(2.556)		
EDW	-0.005	-0.001	5.884	2.343
	(-0.559)	(-0.100)		
OCCH	0.043	-0.034	0.812	0.391
	(0.760)	(-0.614)		
HOUSE	-0.030	-0.046	0.715	0.452
	(-0.619)	(-0.953)		
COASTAL	-0.052	0.069	0.432	0.496
	(-1.093)	(1.482)		
DISTPOB	-0.019*	-0.028**	3.568	1.958
	(-1.647)	(-2.430)		
DISTCGY	0.001	0.006***	45.397	15.874
	(0.972)	(3.288)		
DISTFPC	0.001	0.0000	12.083	24.798
	(0.972)	(-0.000)		
FPINDEX	-0.0002	-0.0002	105.986	148.498
	(-1.445)	(-1.031)		
HELEC	0.198***	0.139**	0.197	0.398
	(3.409)	(2.343)		
AELEC	—	0.242***	0.561	0.497
		(3.940)		
Constant	0.614	0.242		
R^2	0.061	0.093		
F	3.377	4.499		
n	421[a]	421		
Mean	0.240	0.240		
Std. Dev.	0.427	0.427		

*Significant at the .1 level
**Significant at the .05 level
***Significant at the .01 level

(t-values are in parentheses)

[a]Sample excludes currently pregnant women.

main hypothesis is that rural electrification, interacting with other rural development efforts, generated social and economic changes that created downward pressures on fertility; and further, that these pressures, together with the provision of modern family planning services, brought about the sharp decline in birth rates observed in the study areas.

The preliminary analysis reported here suggests that, controlling for basic background socioeconomic factors, current fertility was significantly associated with the presence or absence of rural electrification in the sample areas. In addition, both the presence of electrification in the community and in the household were significantly associated with the current practice of modern family planning methods. The specific mechanisms through which rural electrification affects fertility and family behaviour were not tested in this study because of data processing constraints. However, some further analysis is now available in Herrin.[21]

In view of the incompleteness of the analysis to date, it is difficult to be firm about specific policy implications of the study. It is possible, however, to indicate general considerations regarding the thrust of the rural electrification programme. It should be noted that the areas covered in this study represent the most rural areas potentially accessible to rural electrification. As such, they tend to include the poorest segments of the provincial population. The fact that only one-third of the households in the West, where the rural electrification project has been in operation since late 1971, had an electric connection in 1979 suggests that the benefits of electrification to households have yet to be fully realized for the majority of rural households. Because the incidence of household electric connection is closely associated with income, it would appear that those without household electric connections represent the poorest among the poor. For the poorest group to obtain the benefits of direct electricity use, it would appear that supplementary programmes are needed to enable these groups to have access to electricity. Such programmes could include subsidies over and above those already provided by the project. The crucial policy question is whether this is the most cost-effective way of providing benefits to the poor. While the present study cannot resolve such a question, it can provide useful insights into some of the potential and as yet unmeasured effects of rural electrification, including its direct and indirect effects on demographic behaviour, which in turn can have long-term beneficial impacts on the socioeconomic status of rural households. It is premature at this point, however, to delineate fully such impacts until the results of the analysis on specific mechanisms has been completed.

From a research standpoint, it is now well appreciated that rural development programmes can have indirect consequences on various aspects of household behaviour, including fertility and family planning behaviour. However, as this study suggests, the task of empirically sorting out and statistically testing the significance of these consequences is not an easy one. From an operational standpoint, the implementation of theoretically superior research designs is often not feasible, partly because of the nature of project implementation, various constraints in funding, and temporal commitments of funding agencies and researchers. While research of the type represented by this study can be ex-

pected to contribute to the development of a reasonable *ex post* impact evaluation methodology, it would appear that the task of impact evaluation could be made much easier if policy-makers and project implementors could be persuaded to include as part of development projects a built-in mechanism for system evaluation. This implies that project implementation explicitly take into account at least some of the basic requirements of more adequate research evaluation methodologies. For example, allowance for a baseline socioeconomic and demographic survey could be made before the development project is actually implemented in specific areas. In this way, the impact evaluation could provide firmer conclusions useful for future resource allocation decisions by development planners.

NOTES

Chapter Two

1. This study was supported by a Rockefeller Foundation Project Grant (RF76085). Part of the data collection was also supported by FAO/UNFPA Project Grant INT/76/P18. Miguel Fabello and Lita Palma, as well as the research staff of the Research Institute for Mindanao Culture, Xavier University, provided able assistance at various stages. Fe Lisondra provided programming assistance and Wilma Solidor typed the manuscript.
2. Dumol, P., "Rural Electrification and Employment Generation: Case Study of Two Pilot Projects." *Philippine Economic Journal,* v. 12, 1973, pp. 101-112.
3. National Electrification Administration (NEA), "Nationwide Survey on Socioeconomic Impact of Rural Electrification." (Philippines, 1978).
4. Madigan, F.C., A.N. Herrin and W.F. Mulcahy, "An Evaluative Study of the Misamis Oriental Rural Electric Service Cooperative, Inc. (MORESCO)." Report prepared for the United States Agency for International Development, 1976.
5. Herrin, A.N., "The Employment Effect of Rural Electrification: A Preliminary Report on the Dynamics of Change in a Philippine Setting." Paper prepared for the Seminar on Labor Supply, Council for Asian Manpower Studies and the Organization of Demographic Associates, Manila, 1976.
6. Herrin, A.N., "Rural Electifiction: A Study of Social and Economic Impact in Western Misamis Oriental." *Philippine Sociological Review,* v. 24, 1977, pp 129-138.
7. Herrin, A.N. and F.C. Madigan. "Rural Electrification: A Study of Social and Economic Effects in Misamis Oriental, Philippines." (Philippines: Research Institute for Mindanao Culture, Xavier University, 1977).
8. Herrin, A.N. "Rural Electrification and Fertility Change in Southern Philippines." *Population and Development Review,* v. 5, 1979, pp 61-86.
9. ASEAN/UNFPA funding began in 1980. Additional sample villages and households were surveyed under this project component, including a new substratum (municipal town centers) not covered by the FAO and Rockefeller components. Results of this project will be reported elsewhere.
10. A *barangay* is a village consisting usually of 500 or so people. A municipality is an area comprising an average of ten *barangays,* with the town center called the municipal *poblacion.*
11. Gingog City has a 1975 population of 66,377.
12. This section draws heavily on Herrin, 1979. (See Note 8, above.)
13. Population growth rates in the country as a whole were 3.0 per cent and 2.7 per cent, respectively.

14. The main outlines were discussed in the Workshop on Fertility Impact of Rural Development and Agricultural Practices: A Search for Linkages. Bangkok, Thailand, 1979.
15. The authors use the term coined by Davis in a much broader sense, seeing responses to development pressures as not only demographic (fertility, mortality and migration) but also social and economic. See Davis, K., "The Theory of Change and Response in Modern Demographic History." *Population Index,* v. 29, 1963, pp 345-366. See also Friedlander, D. "Demographic Responses and Population Change." *Demography,* v. 6, 1965, pp 359-381, and Bilsborrow, R.E. "Population Pressures and Agricultural Development in Developing Countries: A Conceptual Framework and Recent Evidence." *World Development* (forthcoming). ED.
16. However, see Oppenheimer on the (non-) effects of increased availability of consumer durables on women's labour force participation in the U.S. Oppenheimer, V., *The Female Labor Force in the United States: Demographic and Economic Factors Governing Its Composition* (Berkeley, CA: University of California at Berkeley, 1970). ED.
17. Cf. Seltiz, C., M. Jahoda, M. Deutsch, and S.W. Cook. *Research Methods in Social Relations* (New York: Holt; London: Methuen, 1959).
18. Or households. ED.
19. The elected head of the *barangay.*
20. This may be due in part to the difficulty—and hence unreliability—of measuring the dependent variable, fertility preferences, or to the fact that such preferences are not well-formulated in the respondents' minds. Previous studies have had difficulty with this concept in other countries. ED.
21. Herrin, A.N. "The Demographic Impact of Rural Development Programs: The Case of Rural Electrification and Fertility Change in Misamis Oriental, Philippines." Paper presented at the Sixth National Population Welfare Congress, Nov. 17, 1983.

APPENDIX 1

HOUSEHOLD SURVEY

A. WIFE'S INTERVIEW

Block 1. Identification

Block 2. Household Composition and Characteristics
Names of household members and relationship to the head, sex, age, education, present occupation, and marital status.

Blocks 3-4. Marriage and Pregnancy History
Wife's age at first marriage and marriage history, pregnancy history of eligible woman, including outcome of each pregnancy, date of birth of child, sex, and survivorship status and date of death if the child died. Also, desires for additional children and breastfeeding behavior.

Block 5. Family Planning
Awareness, knowledge and sources of knowledge about modern and traditional family planning methods; timing of first use and method used, current use of family planning. Availability of family planning services in the area, distance, and contacts with clinic personnel or family planning motivators.

Block 6. Health Service Usage/Morbidity and Mortality
Incidence and type of illness (acute or chronic) for members of the family during the past month, whether health personnel (traditional or modern) consulted, location, whether sick member confined in a health facility, cost of confinement and cost of medicines, if any. Information on deceased members of the family during the past 12 months, date of death, age, cause, and whether a health personnel was consulted, and cost of both confinement and medicine.

Block 7. Work History of Woman
Work history of the woman corresponding to her pregnancy history; nature of work, number of hours worked per given time period, place of work, amount and form of remuneration or earnings received.

Block 8. Organizational Participation
Names and types of organizations (civic, church, community, etc.) in which the woman is a member and extent of her involvement.

Block 9. Housing and Homelot
Type of construction of dwelling units and ownership of house and homelot. Characteristics of structure: number of rooms, type of lighting, fuel used for cooking, water source, toilet facilities, and housing improvements during the past 12 months and costs. Access to transportation from home to nearest town.

Block 10. Consumer Durables
Major consumer durables owned, both electric and non-electric and value. For each asset means of acquisition, date and amount of any outstanding debt and source of credit. For households with electricity, year of connection, cost of installation, and source of financing such installation. If through credit, the source

of credit and amount of outstanding debts. Uses of electricity in the home, monthly electricity consumption and monthly electric bill.

Block 11. Food Expenditures and Consumption
Major food items purchased during past week, quantity and prices. Amount consumed during past week and proportion of consumption obtained from own production.

Block 12. Non-Food Expenditures
Household expenses on items other than food, such as clothing, cleaning supplies, transportation, personal expenses, utilities, entertainment, expenditures for wedding, baptism, festivals, gifts, household help. (The reference used for each item is based on the shortest period possible.)

Block 13. Expenditures on Schooling
Household members attending school academic, vocational, and other types of training); amount spent for tuition, books, supplies, transportation, board and lodging.

Block 14. Savings and Adjustment to Consumption
Modes of savings and planned expenditures within a given time period. Modes of adjustment to consumption when income unexpectedly increases or decreases and times of the year when such changes normally occur. Information for determining changes in consumption and expenditures patterns due to seasonality of income and variation in available household resources.

Block 15. Time Allocation in Home Production
For each member of the household, time allocated to each major household production activity, and estimated replacement cost of services.

Block 16. Time Allocation and Production in Home Gardening
Cost associated with home gardening during past year, including cost of non-family labor. Time allocation of each member of the household and estimated replacement cost.

Block 17. Time Allocation in Paid Employment
Information on each household member working for pay (wages and salaries), type of work performed, place of work, time to travel to and from the place of work, and transportation costs. Hours worked per day, days per month, and months per year, and amount of remuneration received.

*Block 18. Costs and Benefits of Children**
Perceived costs and benefits of children, including attitudes about advantages and disadvantages of having large or small families (large or small as defined by the respondents themselves), perceived financial burden of additional children, perceptions regarding expected economic contributions of children as productive agents and as source of old age security, educational aspirations for children and expected means for supporting such aspirations. Also, extent of husband-wife communication with respect to major household decisions, including number of children to have.

Block 19. Perceptions of Quality of Life
Measures of present satisfaction with respect to various aspects of household's condition, as well as present satisfaction relative to the past and expected future conditions.

B. HUSBAND'S INTERVIEW

Block 1. Identification

Block 20. Crop Farm Data
Land tenure patterns, value of land owned, and crops planted by parcel of land owned, cropping patterns in these parcels for the past two years.

Blocks 21-25. Specific Crops (Production/Costs/Family Labor)
Data on production costs and family labor for each crop, including coconut, rice, corn and tobacco. (Data reckoned in terms of last cropping or harvest season for rice, corn and tobacco and last two harvest seasons for coconuts.) For each crop planted, sizes of the areas planted and harvested. For rice, type of irrigation (whether electricity-dependent or not), use of harvesters/threshers, landlord payments, and the operator. For operator's share, quantity given away as gifts, consumed and sold. For the latter, prices at which the operator sold the output.

Types of labor: hired labor, unpaid family labor and exchange labor. For each, work time and replacement cost in each major work activity. Work done by children up to 6 years old and by those over age 6.

Costs of seeds, fertilizers and other miscellaneous inputs, and any procedures for sharing expenses between landlord and operator.

Block 26. Farm Crop Capital Items
Number and present value of farm crop capital items, including small and large farming tools, vehicles, hand-powered or electric-powered machinery, mode of acquisition and debt status.

Block 27. Farm Crop Financing
For each crop, amount of funds borrowed and purpose for borrowing, source of credit, date debt was acquired, mode of payment, interest rates, and amount of debt outstanding.

Block 28. Livestock/Poultry
Type of livestock/poultry raised during past 12 months, amount and value of family labor used, annual production and cost of raising each category of livestock/poultry, and sources and amount of any loans.

Block 29. Marine Fishing
Fishing activities of family members during last 12 months, value of fish production by species, annual fish production costs by cost item and inventory of fishing capital items owned by household, value, and mode of acquistion.

Block 30. Business or Trade Income
Type of business or trade each of the household members was engaged in the past 12 months, amount of time worked, assets used in business or trade, present value and debt status. Also, gross income, expenses and net income.

Block 31. Household Income for Other Sources
All other sources of income and amounts received during past 12 months, including rents, interests, pension, gifts and inheritances, and remittances, including goods received in kind.

Block 32. Migration and Employment History
Migration behavior of husband and his employment history (type of work and remuneration) from 1970 to the current period. Reasons for past migration and plans for future migration. Also, perceptions of income changes and sources of such changes during the past 8-9 years.

Block 33. Organizational Participation
See Block 8.

Block 34. Cost and Benefits of Children
See Block 18.

Block 35. Perception of Quality of Life
See Block 19.

APPENDIX 2

COMMUNITY SURVEY

Block 1. Population
Population size, land area and ethnic composition of barangay.

Block 2. Transportation
Distance of barangay from nearest municipal poblacion, transport facilities available, both within the barangay and between the barangay and poblacion. For the latter, travel time and cost of roundtrip fare.

Block 3. Educational Services
Type and number of schools in barangay; if not located in the barangay, nearest place where facilities are located, distance, usual mode of travel by students, travel time and cost.

Block 4. Health and Environmental Sanitation
Health and family planning facilities available in barangay; if not in barangay, nearest place, distance, usual mode of travel, travel time and cost. Presence of public or private medical and family planning personnel in barangay including traditional health personnel; or, if not resident in barangay, frequency of visits to the barangay; or if no visits, distance, travel time and cost of travel to such personnel. Type of water supply in the community, toilet use pattern of residents, and most prevalent illness of infants, children and adults.

Block 5. Economic Activities
Distribution of household heads by main occupation, major types of crops cultivated in area and presence of irrigation facilities; types of extension workers making visits; location of nearest suppliers of modern agricultural inputs, distance and cost of travel; usual buyers of major crops; types and numbers of selected commercial establishments in barangay; if not in barangay, distance to nearest establishment, mode of travel and cost.

Block 6. Public Service Facilities
Presence in barangay of various public facilities; if not in barangay, distance, and cost of travel to nearest (e.g., post office, police station, barangay or municipal halls, churches) etc.

Block 7. Organizations
Major types of organizations in barangay, number, total membership and frequency of meetings (farm, social and religious organizations).

Block 8. Social and Development Activities
Barangay-sponsored social activities; on-going, completed and proposed barangay development projects. For each development project, name of government or private support agency and nature of support.

APPENDIX 3

LIST OF VARIABLES

Variable Symbol	Description	Measurement
A. Dependent		
WAC	Want additional children	1 = No; 0 = Yes
FP	Current use of any family planning methods	1 = Yes; 0 = Otherwise
MFP	Current use of modern family planning methods (i.e., pills, IUD and sterilization)	1 = Yes; 0 = No
LB2	Live birth during the past 24 months (i.e., between January 1, 1977, and December 31, 1978)	1 = Yes; 0 = No
LB5	Live birth during the past 5 years (i.e., between January 1, 1974, and December 31, 1978)	Actual number of live births during the past 5 years
B. Independent		
AGEW	Age of woman	Actual age as of last birthday
CSD	Number of living children as of interview date	1 = Four or more; 0 = Three or less
CS74D	Number of living children before January 1, 1974	1 = Four or more 0 = Three or less
CS77D	Number of living children before January 1, 1977	1 = Four or more; 0 = Three or less
EDW	Education of wife	Highest grade of schooling in years
EDH	Education of husband	Highest grade of schooling in years
OCCH	Occupation of husband	1 = Farmer 0 = Otherwise

Variable Symbol	Description	Measurement
HOUSE	Type of materials used in house construction	1 = Light materials 0 = Mixed or heavy materials
COASTAL	Whether the household is residing in a coastal barangay or not	1 = Yes; 0 = No
DISTPOB	Distance of the barangay from own municipal poblacion	Actual distance in kilometers
DISTHWY	Distance of the barangay from the national highway	Actual distance in kilometers
DISTCGY	Distance of the barangay from the provincial capital, Cagayan de Oro	Actual distance in kilometers
DISTFPC	Distance of the household from the nearest family planning clinic as reckoned by the respondent (wife)	Reported distance in kilometers
FPINDEX	Family planning exposure index	Number of person-years family planning personnel visit the barangay
HELEC	Whether household has electric connection or not	1 = Yes; 0 = No
AELEC	Whether the barangay is electrified or not	1 = Yes; 0 = No
HR70	Whether the household has been resident in the area since 1970	1 = Yes; 0 = No

THE EFFECTS OF ELECTRIFICATION AND THE EXTENSION OF EDUCATION ON THE RETENTION OF POPULATION IN RURAL AREAS OF COLOMBIA

Juan ter-Wengel[1]

A prominent problem confronting many developing nations is massive rural-urban migration.[2] The mass movement of people from rural areas to cities has widespread social and economic costs, such as the costs of congestion and of providing the necessary infrastructure in cities, the depletion of human capital from the countryside, and the exacerbation of urban unemployment problems, with accompanying social resentment and political unrest. Therefore, it is important to study the extent to which rural development projects influence the retention of people in the countryside.

The findings of such studies may lead to policy prescriptions different from the generally accepted but difficult-to-implement goal of raising rural incomes to reduce the potential economic benefits of migration. Investigation of the demographic impacts of development projects is also important because it provides additional criteria by which to judge the desirability of such projects. For example, in the context of cost-benefit analyses, the benefits should include cost savings resulting from the retention of the population in the rural areas (if it can be assumed that the social and economic costs of rural-to-urban migration exceed the benefits).

Although the relationship between economic development, in general, and migration has been studied often, little is known of the impact of specific policies and projects on migration. The purpose of this study is to examine the retention impact of particular projects not purposefully designed to affect population distribution. These two projects are electrification and extension of the school programme in two villages in northern Cundinamarca Department, Colombia.[3] One aim is to compare the effects of the two types of projects on the rates of out-migration.

However, two disclaimers must be made at the outset. First, the purpose is not the formulation of a model to explain migration decisions at the individual level. Second, the study is not a cost-benefit analysis. Thus, attention is limited to the measurement of the migration flows and no extensive attempt is made to estimate their costs and benefits.

In the first section, I present the methodological framework, including hypotheses and the experimental design formulated for their verification. In the second section, I discuss the criteria for the selection of projects and towns

and examine the design and implementation of the household survey. The third section contains the empirical results and the fourth section, the conclusions, including policy implications and suggestions for further research.

METHODOLOGICAL FRAMEWORK

Few studies have related development projects to population variables. This fact implies that there is little guidance in the literature concerning appropriate methodologies that could be used or problems that may be encountered in such research. Thus, for example, little has been written about the problems of maintaining comparability across areas, correct specification of variables, or methods to use to collect data when resources are limited.

The most straightforward way of determining the retention impact of projects would be through a longitudinal study of the migration flows of a population before and after it benefits from a project. Such an approach, however, presents three interrelated difficulties. First, it would take a long time to measure differences in migration flows over time. Second, over such a period of time it is likely that other variables that affect migration patterns also would change. Finally, there would be no way to control for exogenous changes taking place *outside* the community that might cause changes in general migration flows within the region.

The need to control for exogenous factors can be met by carrying out the study in two communities, one benefitting from the project and the other serving as a control. The relative changes in the migration flows between the two villages could then be attributed to the effects of the project.

Nevertheless, even if the problems of length of time and controls for exogenous factors could be resolved by the use of a control village, it would appear unlikely that in the medium term—the period necessary for people to make migration decisions—nothing else besides the particular project would have changed within the communities themselves. If other things change in the communities, such as the implementation of another development project, then it may be impossible to discriminate between the impacts of the different projects.

Taking the individual as the unit of analysis, the impact of development projects and exogenous changes can be assessed with a logit regression model that specifies the dependent variable (migration) as a zero-one variable, with characteristics of individuals and exogenous changes as independent variables. We have formulated such a model to examine the migration decisions from 1970 through 1979 for the populations of Villa Gomez and El Penon, two villages in Northern Cundinamarca, Colombia. The two villages were chosen because of their similarity in size, area, climate, agricultural base and distance from the nearest important city attracting migrants (as will be discussed in the next section). The main differences between the towns in 1980 was that El Penon was electrified in June 1976 and Villa Gomez[4] extended its school programme to include the last two years of secondary school in February 1977 and February 1978, respectively (the beginning of the school year).

The model designed to measure the retention impact of the electrification of El Penon and the extension of the school programme in Villa Gomez is the following:

$$(1)\quad M_i = bo + b_1\ Vill + b_2\ (Vill \times Age\ 15\text{-}19)_i + b_3\ Y_i + b_4\ \ Educ_i + b_5\ \ Sex + b_6\ Relship_i,$$

for i = 1970.....1979, where,

M_i = migration, a zero-one variable equalling zero if the person remained in the town and one if he out-migrated in year i;

b_i = regression coefficients for variable k (= 1,2,..6);

Vill = dummy variable indicating the village; 1 = Villa Gomez, 2 = El Penon;[5]

(Vill x Age 15-19) = interaction term designed to measure the effect of the extension of the schooling programme in Villa Gomez. It is a zero-one variable, taking on the value of one only if a person resides in El Penon and also is of age 15-19 in year i;

Y_i = person's income in year i (in Colombian pesos);

$Educ_i$ = years of education attained by person by year i;

Sex = sex (male = 1, female = 2);

$Relship_i$ = zero-one variable taking on the value of 1 in year i if previous members of the household had emigrated to the destination area and zero otherwise.

The model presented in equation (1) is estimated separately for each year between 1970 and 1979. The analysis of the impact of electrification as well as of the extension of the school programme is performed by comparing the village and interaction coefficients respectively for the various years studied. It is hypothesized that the coefficients of the variable indicating village should be smaller after 1976, when El Penon was electrified because El Penon was assigned a larger number (2) than Villa Gomez (1). It is also hypothesized that the coefficients for the *interaction* variable will be larger after 1977-78, as the young people should have a greater tendency to leave El Penon than Villa Gomez, where the school programme was extended.

Variables relating to income, education, sex, and relationship were included to take account of individual differences that might also influence migration. However, although income is usually an important determinant of migration, it was included in the model here only for the sake of completeness since its measurement from the survey work was suspected to not be very reliable, particularly for periods in the past.

Level of education was included in the model since it has been widely observed to be an individual characteristic that affects migration. Individuals with higher levels of education demonstrate a greater propensity to move than those less well educated. The sign is therefore expected to be positive.

Sex was included as an explanatory variable since it is believed that women may demonstrate a greater tendency to leave than men because of the lack of job opportunities for women in rural as compared with urban areas. It is thus hypothesized that the coefficient will be positive.

The last variable, relationship, is designed to determine the influence of the presence of relatives at the site of destination. Having relatives who have already left may reduce the costs of moving for an individual by decreasing the costs of obtaining information about destination areas as well as those of the initial stay at the destination. Since the relationship variable was designed to take on the value of one if an individual had family members who had already left and zero otherwise, the coefficients should be positive.[6]

The empirical results obtained with the model can be checked by comparing them with the results of descriptive analyses of complementary data. For example, changes in the reasons given by individuals for migrating at different times may highlight the effects of the extension of the educational system. At the same time changes in the proportion of people who leave for other than educational reasons may suggest the benefits of electrification. I hypothesize that fewer people left Villa Gomez for educational reasons in comparisons to other reasons, in the 1976-80 period than in the 1970-75 period, relative to El Penon. Similarly, an analysis of migration intentions of the student and nonstudent populations may indicate the relative importance of both electrification and the extension of the school programme. Thus, the proportion of nonstudents expressing a desire to migrate is hypothesized to be greater in Villa Gomez than in El Penon.[7]

Finally, the interest of the population in both electrification and education can be assessed from their ranking of the importance of development projects. It is anticipated that a greater proportion of people should rank electrification as important in Villa Gomez than in El Penon. The opposite would be expected to hold with respect to education.

The next section deals with the collection of data necessary for the implementation of the model and for the descriptive tests, and the following section presents the empirical results of the model.

DATA COLLECTION AND DESCRIPTION OF SAMPLE POPULATIONS

There were two reasons for studying an electrification project. First, electrification responds to a generalized and collective need affecting the whole population, although not necessarily equally, without regard to age, sex or socioeconomic condition since it benefits both consumers and producers. Second, electrification has ranked as one of the top priority development projects of the Government of Colombia in recent years, as evidenced by its emphasis on rural electrification.

The extension of the educational system was chosen as a second development project because of its expected different effects on patterns of outmigration. The difference between Villa Gomez and El Penon in educational facilities was fortuitous (see below) for the study of the retention impact of the recent extension of the school programme in Villa Gomez, though the direct effects were only expected to be on the population aged 15-29.

The selection of the two towns was based on the following three requirements: (1) they be as similar as possible, (2) only one be electrified (so that the other could serve as control), and (3) the electrification be recent enough to permit accurate measuring of differences in migration before and after the project. Given the wide extent of electrification in Colombia, the principal constraint was locating a town without electricity that would also be comparable to one recently electrified, in order to investigate the effects of electrification. It was fortunate that the town which was not fully electrified had expanded its educational system recently, permitting a broader investigation than had been planned originally.

The comparability of Villa Gomez and El Penon was established according to the following six criteria:

1. *Geographic location.* Both towns are located in the Rio Negro district in the northwestern part of the Department (province) of Cundinamarca. Though the nearness of the towns (12.5 kilometres in a straight line) suggests great proximity, they are separated by a mountain range, and it takes 90 minutes to travel between them by unpaved road. This prevents the students in El Penon from benefitting from the extension of the school program in Villa Gomez, as well as the residents of Villa Gomez from benefitting from the electrification of El Penon.
2. *Ecological conditions.* Villa Gomez and El Penon are situated at similar altitudes above sea level (1,575 and 1,310 metres, respectively) and have temperate climates year-round. Thus, the vegetation is similar and agricultural possibilities also comparable.
3. *Population.* According to the 1973 national census, the populations of El Penon and Villa Gomez were 561 and 652, respectively. The ratio of men to women was also roughly similar, being .94 in El Penon and .90 in Villa Gomez. Age structure data were not available.
4. *Economic activity.* The main economic activities in both towns were agriculture and cattle raising. In Villa Gomez, there was some mining of little importance. The main crops were essentially the same: coffee, sugar cane, corn, beans, yuca or casava, bananas and plantains, and fruits. More coffee was grown in El Penon (1,480 hectares planted) than Villa Gomez (875 hectares), but this does not reflect higher productivity or incomes but rather the greater area of El Penon (135 kilometres vs. 50 kilometres for Villa Gomez).
5. *Education.* Both towns had a secondary school during the period, although in El Penon the highest grade attainable is tenth, out of twelve necessary for completing secondary education. The last two years were added in 1977 and 1978 in Villa Gomez to complete the standard Colombian high school curriculum.

UNIVITY HEALTH
LIBRARY
DEM-100
N85

6. *Distance to the poles of regional development and Bogotá.* The two towns are equidistant from Pacho (25 kilometres), the nearest pole of regional development, and from Bogotá (115 kilometres) the main destination of out-migrants. Bus fares from both towns to Pacho and to Bogotá were also the same.

To determine the migration impact of the projects, a detailed questionnaire to be answered by household heads was designed. Its implementation was preceded by several on-site inspections carried out to become familiar with the populations of the towns and to encourage the interest of municipal authorities in the study.

The instrument was designed after carefully listing and subdividing the different variables contemplated in the study into components. This process served to help identify those indicators expected to most easily permit the estimation of the desired variables. This step led to the formulation of a preliminary instrument that was pretested in a survey of 20 representative households in each town.[8] On the basis of the results, the questionnaire was modified for the definitive survey of the two towns. The final questionnaire was designed to be answered by urban household heads in the two towns.[9] The instrument sought information about the characteristics of the population, the use of electricity and consumption in general, and production activities. A brief indication of the contents of each of these three sections is presented below.

In the population section, information was collected on the age, sex, and place of origin (previous residence) of current household members, as well as those former members who had left or died in the previous ten years. Questions about out-migrants included their level of education, whether presently attending school, relationship to the respondent, place of destination (but not current residence), and principal reasons for migrating. Questions about return migrants and potential out-migrants also were asked.

In the section on general consumption and use of electricity, information was sought that would indicate the standard of living or income of the household. Inquiries were made with respect to food consumption (in the past week, by type of food, weight, and whether purchased or self-produced) as well as a list (open ended) of consumer durables purchased "in the past year" and their cost. Information about payments for three household services—water, sanitation, and electricity—was obtained. In the case of electricity, we asked whether the household had it, whether it was from the national network or the municipality, the cost per month, the year in which it was installed, and the installation cost. We asked separately whether the household used electricity in any nonfarm activities, but not about use in farm operations. Questions seeking the degree of satisfaction of the households with local educational facilities also were formulated,[10] as well as an open-ended question asking what development projects the respondent considered the most important. We asked the latter questions before the direct questions about attitudes towards education and ownership of electrical appliances, because we wanted to avoid its being biased by prior responses to other questions.

The production activities section sought information from which household incomes and the distribution of wealth could be deduced. Questions were posed

on house and land ownership, employment, and commercial and agricultural activities. The latter included land use and production of coffee and other crops "for the past two years," and total costs by crop lumped into labour and other. Labour costs were in turn broken down by name of labourer, whether permanent or temporary, payment amount and basis (money or in kind). Income and costs from animal raising and other businesses and use of farm machinery also were obtained. Although this section consumed considerable time and effort, given the reticence of people to talk about income and wealth, the results may not be as satisfactory as hoped.

The questionnaire was administered to all household heads in the two towns. Ten local residents (secondary school students and teachers) were recruited as interviewers in each town and were under the direction of a supervisor. It was deemed preferable to employ local students and teachers for three reasons. First, they personally knew the population to be surveyed, reducing the possibilities of refusal or being supplied erroneous information. Second, they represented the population's best-educated members, and were expected to be the most adequate interviewers. Finally, the provision of extra income and work experience to local residents was expected to be appreciated in the communities. This may have contributed to the extensive co-operation offered by the municipal and ecclesiastical authorities.

The survey provided information much greater than that necessary for the testing of our model. Some of this information is helpful in establishing the comparability of the towns and in providing a fuller picture on the impact of electrification and the extension of the educational system in El Penon and Villa Gomez, respectively. Therefore, a brief description of some of these data is presented below.

Although considerable efforts were expended to survey all households, some household heads were adamant in their refusal to respond to the questionnaire. The nonresponse rates were 12 per cent in El Penon (11 of 91 households) and 8 per cent in Villa Gomez (10 of 130). The total population sizes in 1980 were 393 and 537, respectively, with both towns having more females than males (54.4 and 53.4 per cent, respectively).[11]

Given that the purpose of the project is the determination of the retention impact of development projects, special attention was paid to migration. The data on migration are based on the respondents' recollection of when the members of the household arrived if they were not born in the towns, and the dates of departure of those who out-migrated. For the absolute numbers and the rates of out-migration from each town in each of the ten years prior to the survey see Table 1; for the numbers of in-migrants see Table 2.[12],[13]

Since the extension of the school programme is a development project of major interest here and since education may have many effects on migration, possibly tending to retain the population, specific questions were asked about school attendance. Table 3 shows school attendance levels and rates by single year of age in Villa Gomez and El Penon.[14] Although the high ratios of school attendance indicate a strong interest in education, most respondents indicated dissatisfaction with the type of education offered, the academic school, as seen in Table 4.

Table 1

NUMBERS OF OUT-MIGRANTS AND GROSS RATES OF OUT-MIGRATION, 1970-1979/80

Town	1970		1971		1972		1973		1974		1975		1976		1977		1978		1979/80	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
El Penon	20	5.3	2	0.5	10	2.6	10	2.6	11	2.8	8	2.0	11	2.6	24	5.4	8	1.8	35	7.4
Villa Gomez	12	2.8	3	0.7	11	2.5	7	1.6	8	4.8	15	3.2	23	4.7	16	3.1	25	4.6	27	4.7

Table 2

NUMBERS OF IN-MIGRANTS, 1970-1979/80

Town	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979/80
El Penon	17	4	16	4	5	27	13	26	11	33
Villa Gomez	11	2	4	3	9	19	29	41	23	48

Table 3

SCHOOL ATTENDANCE IN EL PENON AND VILLA GOMEZ

	El Penon			Villa Gomez		
Age	Total persons	No. attending school	Per cent attending school	Total persons	No. attending school	Per cent attending school
6	10	5	50.0	13	8	61.5
7	10	6	60.0	8	6	75.0
8	8	6	75.0	15	13	86.7
9	9	8	88.9	17	16	94.1
10	7	6	85.7	9	9	100.0
11	8	8	100.0	17	17	100.0
12	11	8	72.7	11	11	100.0
13	14	12	85.7	12	9	75.0
14	7	6	85.7	9	6	66.7
15	8	6	75.0	18	13	72.2
16	12	9	75.0	8	7	87.5
17	15	8	53.3	11	6	54.5
18	13	10	76.9	9	4	44.4
19	7	5	71.4	8	5	62.5
20	11	3	27.3	7	2	28.6

Table 4

PREFERRED TYPE OF EDUCATION

	El Penon		Villa Gomez	
Preferred Type of Education	Favourable Opinions	Per cent	Favourable Opinions	Per cent
Academic	4	5.0	2	1.6
Agronomic	22	27.5	21	17.5
Commercial	6	7.5	39	32.5
Technical - Industrial	38	47.5	33	27.5
Others	3	3.7	5	4.1
No information	7	8.7	20	16.6
TOTALS	80	100.0	120	100.0

Data on incomes corroborate the belief that the towns are comparable. Mean values given were 10,552 pesos per month in El Penon and 9,180 in Villa Gomez, amounting to 2,014 and 2,052 per capita, respectively. Average household expenditures on food were also very similar—1,706 and 1,597 pesos respectively.[15]

Regarding electrification of houses, 78 per cent in El Penon and 67 per cent in Villa Gomez had electricity in 1980. However, in Villa Gomez this meant having electricity from the municipal plant when it worked, which was often not the case, and then only from 6:00 P.M. to 9:00 P.M.

Table 5 indicates the acquisition of electrical goods by households in El Penon and Villa Gomez for each year during 1970-80.[16]

ELECTRIFICATION AND THE EXTENSION OF THE SCHOOL SYSTEM: EFFECTS ON THE RETENTION OF POPULATION

Our model was estimated for each year from 1970 to 1979/80 for the age group 15 to 29 in various ways, systematically excluding some of the variables specified for each year for the group. Attention was focused on this age group because the bulk of out-migration from both towns (57 per cent) was concentrated in these ages.

In the estimation of the model, individuals who had left as entire households were excluded for several reasons. First, some of them constituted a mobile population that moves in and out of rural towns for exogenous reasons, such as the police, school teachers, doctors, health personnel, and others who are often periodically transferred by the central or national government. Second, data on the characteristics of former households proved scanty.[17]

The model was estimated in various ways to exclude variables that demonstrated little explanatory value. As a result sex, education, and income variables were omitted from the main results presented. The income variable was left out *a priori* because income figures appeared unreliable except for the most recent years. Moreover, the estimation of the model using "necessary" household income[18] divided by the number of household members did not yield any statistically significant coefficient for any year between 1970 and 1979-80. The education variable also turned out to be not significant in any of the years and was therefore excluded. This probably can be attributed in part to the fact that total years of education attained by 1980 was used as a proxy for years of education at the time of leaving. It was necessary to use this proxy because education at the time of leaving was not sought in the questionnaire. Finally, and also contrary to expectations, sex had little explanatory value, probably because the study concentrated on the urban centres of the two towns rather than including their rural fringes where female employment prospects might have been more limited.

The final form of the model estimated thus became:

(2) $M_i = b_o + b_1\ \text{Vill} + b_2\ (\text{Vill x Age 15-19})_i + b_3\ \text{Rltship}_i$,

for i = 1970...1979/80, and the remaining variables are all as defined before.

See Table 6 for results.

Table 5

ELECTRICAL GOODS IN USE IN VILLA GOMEZ AND EL PENON*

Item	Total	Year of Acquisition 80	79	78	77	76	75	74	73	72	71	70
Television												
Villa Gomez	12	—	1	—	2	3	1	1	1	3	—	—
El Penon	33	7	3	7	5	7	2	—	1	1	—	—
Tape recorder												
Villa Gomez	2	1	—	1	—	—	—	—	—	—	—	—
El Penon	9	5	3	—	1	—	—	—	—	—	—	—
Stereo system												
Villa Gomez	2	—	—	—	—	—	—	1	1	—	—	—
El Penon	13	1	4	—	1	2	2	1	1	—	—	1
Refrigerator												
Villa Gomez	0	—	—	—	—	—	—	—	—	—	—	—
El Penon	17	2	6	7	1	—	1	—	—	—	—	—
Stove												
Villa Gomez	1	—	—	—	—	—	—	1	—	—	—	—
El Penon	15	7	3	2	2	—	—	1	—	—	—	—
Blender												
Villa Gomez	7	—	—	1	2	1	1	—	—	1	1	1
El Penon	30	4	5	5	7	6	2	—	—	1	—	—
Iron												
Villa Gomez	14	—	1	3	—	3	1	1	—	2	—	3
El Penon	43	5	4	9	8	8	4	3	—	—	—	2
Washing machine												
Villa Gomez	0	—	—	—	—	—	—	—	—	—	—	—
El Penon	3	—	1	1	1	—	—	—	—	—	—	—
Radio (electric)												
Villa Gomez	1	—	—	—	—	—	—	—	—	—	—	1
El Penon	3	1	—	—	—	2	—	—	—	—	—	—
Sewing machine												
Villa Gomez	3	1	1	1	—	—	—	—	—	—	—	—
El Penon	4	1	—	—	—	1	—	—	2	—	—	—
Totals												
Villa Gomez (N=120)	42	2	3	6	4	7	4	3	2	6	—	5
El Penon (N= 80)	170	32	30	31	26	26	11	5	4	2	—	3

*Total number of households interviewed = 120.

The evolution of the coefficients of Table 6 lends support to the hypotheses that expansion of electrification and education systems tends to retain population in rural areas. The coefficients for the village dummy variable designed to measure the impact of electrification indicate that the propensity to leave El Penon relative to Villa Gomez was generally greater before El Penon was electrified in 1976 and smaller afterwards. The coefficients for 1970-74 may be compared with those for 1978 and 1979-80, indicating a lower propensity to leave El Penon relative to Villa Gomez in the later years. The 1975-77 period should be regarded as a transition period, starting as early as 1975, because of the expectations raised by the prospect of impending electrification.

The evolution of the interaction term coefficient suggests that the extension of the school programme in Villa Gomez may have influenced the retention of the population aged 15 to 19, but the results are quite weak. Since the school programme was extended in Villa Gomez to include the last two years of secondary school in 1977 and 1978, respectively, it is nevertheless noteworthy that the sign of the coefficient changed between 1977 and 1978, and that it became significant at the ten per cent level in 1979. Since the interaction term is a dichotomous variable taking on the value of one only when a person is *both* a resident of El Penon and aged 15 to 19, the negative signs for the 1970-77 period indicate a greater tendency for young people to leave Villa Gomez relative to El Penon in those years. The positive signs in 1978-79/80 suggest a greater tendency for youths aged 15-19 to leave El Penon, where the school programme was not extended, relative to Villa Gomez in later years.

Finally, the relationship coefficients are positive, as expected, since the presence of relatives in the place of destination may reduce the costs of moving.

Using the coefficients of equation (2), the probabilities of out-migration from Villa Gomez and El Penon were determined from the logistic function

$$(3) \quad P_i = \frac{e^{x_i}}{1 + e^{x_i}}, \text{ where}$$

P_i = probability of out-migrating in year i, and

$x_i = b_o + b_1 \text{ Vill} + b_2 (\text{Vill x Age 15-19})_i + b_3 \text{ Rltship}_i$.

Introducing the coefficients from Table 6 into equation (3), the probabilities of out-migration can be determined for each town for each year. For these probabilities for individuals aged 20-29 and 15-19, see Table 7. The results are then graphed for the 20-29 age group without relatives at the site of destination (see Figure 1).[19] An examination of Table 7 and Figure 1 shows that the probabilities of out-migration for the 20-29 age group increase in Villa Gomez (the nonelectrified village) over time relative to those of El Penon, particularly after the electrification of the latter in 1976.

Although the results from the model above should be interpreted with caution, it is reassuring that they can be supported by descriptive analyses. For example, in an open-ended question most residents in Villa Gomez emphasized the need to electrify the town,[20] while in El Penon people were more likely to favour education (see Table 8). When household heads were asked why people had left their households, fewer people were reported as leaving El Penon for

Table 6

REGRESSION COEFFICIENTS FOR INDIVIDUAL MIGRATION DECISIONS FOR THE 15-29 AGE GROUP

	Independent Variable				
Year	Constant	Village	Interaction (Vill x Age 15-19)	Relationship	R^2
1970	-7.57**	-2.89**	-0.93	0.69	.074
1971	—	—	—	—	—
1972	-5.12**	1.49	-1.02	0.62	.029
1973	-4.39**	0.79	-1.16	0.37	.007
1974	-5.25**	1.36*	-1.73*	1.64*	.061
1975	-3.02**	-0.61	-0.75	2.24**	.070
1976	-2.14*	-0.59	0.19	1.34*	.041
1977	-4.10**	-0.35	-0.72	2.22**	.071
1978	-0.82	-1.41	0.03	0.80	.040
1979/80	-1.47	-1.15	1.17	1.28	.054

The coefficient could not be calculated as the matrix was ill-conditioned.

*Significant at the .05 level.
**Significant at the .01 level.

Table 7

PROBABILITIES OF OUT-MIGRATION FROM
VILLA GOMEZ AND EL PENON, PERSONS AGED 20-29 AND 15-29

	Persons Aged 20-29				Persons Aged 15-19			
	Individual without previously out-migrated relatives		Individuals with previously out-migrated relatives		Individual without previously out-migrated relatives		Individuals with previously out-migrated relatives	
Year	Villa Gomez	El Penon	Villa Gomez	El Penon	Villa Gomez	El Penon	Villa Gomez	El Penon
1970	0.9	14.2	1.8	24.8	0.9	6.1	1.8	11.5
1971	—	—	—	—	—	—	—	—
1972	2.6	10.5	4.7	17.8	2.6	4.0	4.7	7.2
1973	2.7	5.7	3.8	8.0	2.7	1.8	3.8	1.6
1974	2.0	7.4	9.6	29.2	2.0	1.4	9.6	6.8
1975	2.6	1.4	19.8	11.8	2.6	0.7	19.8	5.9
1976	6.1	3.5	19.9	12.1	6.1	2.9	19.9	10.2
1977	2.3	3.3	17.9	23.4	2.3	1.6	17.9	12.9
1978	9.8	2.6	19.5	5.6	9.8	2.6	19.5	5.3
1979/80	6.8	2.2	20.8	7.6	6.8	6.9	20.0	21.0

Figure 1: Out-Migration Probabilities
15 to 29 Age Group

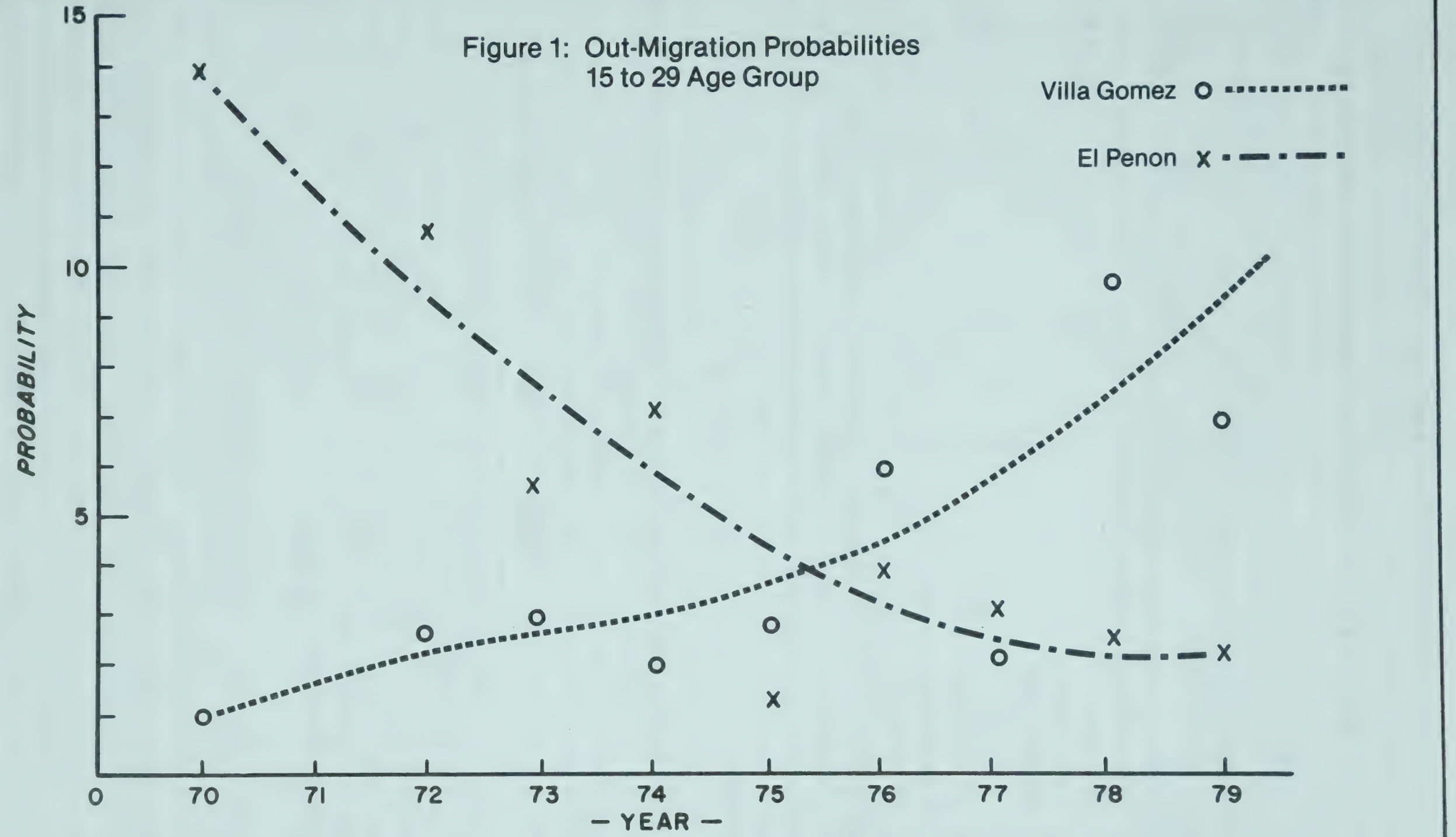


Table 8

REPORTED MOST-NEEDED DEVELOPMENT PROJECTS

Project	El Penon		Villa Gomez	
	1st Choice	2nd Choice	1st Choice	2nd Choice
Education	24	15	2	12
Electricity	1	—	77	14
Bank-credit	13	9	—	3
Marketplace	13	9	3	3
Hospital	8	4	19	15
Pavement of roads	9	11	3	12
Aqueduct	5	2	11	50
Others	5	7	3	6
Without Information	2	7	2	5
Totals	80	80	120	120

Table 9

OUT-MIGRATION INTENTIONS OF STUDENTS AND NONSTUDENTS IN 1980

	Village	Yes*	No	Proportion Yes
Students	Villa Gomez	19	126	.131
	El Penon	21	97	.178
Non-Students	Villa Gomez	49	274	.152
	El Penon	32	236	.119

*Indicates intention to out-migrate.

work and household consumption reasons in the 1975-79/80 period than in the 1970-74 period, relative to Villa Gomez, presumably because of the greater economic opportunities and consumption possibilities facilitated by electrification. Simultaneously, fewer people left Villa Gomez for education reasons in the 1977-79 period relative to the 1970-76 period in relation to El Penon (though the number of cases reported was extremely small in any case). Finally, Table 9 shows that fewer current students[21] intended to leave Villa Gomez than El Penon, while fewer nonstudents intended to out-migrate from El Penon.

Nevertheless, it should be reiterated that the results should not be taken as definitive. Many other influences may also have been at work.[22] At best, the results should be taken as indicative, to be further tested by a horizontal extension of the study, including more electrified and nonelectrified towns and larger population samples. The extension of the period studied does not appear promising, unless longitudinal studies are made. Otherwise, asking about projects further back in the past might not be helpful two reasons. First, the respondents' ability to remember events further back is less reliable. Second, in the longer run, other development projects would have been implemented, making the separate estimation of the retention effects of a *particular* project more difficult to estimate.

CONCLUSIONS

In the first section of this study, it was noted that the analysis of the retention impact of specific rural development projects deserved attention not only because it might permit the formulation of policies to reduce massive rural-urban migration movements, but also because it provided an additional element with which to judge the effects of such projects in general. A model was developed to test whether individual migration decisions were affected by electrification or by the extension of the school programme. In order to implement the model, household interviews were carried out in two villages in the Colombian Andes—Villa Gomez and El Penon. El Penon was electrified in 1976, in contrast to Villa Gomez, which had only very limited municipal service during the decade 1970-80. The school programme in Villa Gomez was extended in 1977-78 to include the last two of the six years of secondary education in Colombia, in contrast with El Penon, which continued to have only the first four years.

The results of the testing of the model indicate that electrification may indeed play an important role in the retention of population. This was also supported by descriptive analysis. With respect to education, the results convey the impression, though less persuasively, that the extension of the school programme may have helped in retaining young people age 15 to 19 in Villa Gomez. Nevertheless, the results should only be taken as suggestive, given the exploratory and limited nature of this project.

A policy implication of the study is that government programmes to expand rural electrification and extend school programmes deserve increasing support to the extent it can be assumed that rural-urban migration causes greater social costs than benefits. Furthermore, cost-benefit analyses of government planners might be usefully amended to include estimates of benefits from the retention of the population in rural areas.

Finally, with respect to further research, it is clear that the present study would greatly benefit from an extension to more electrified and nonelectrified villages and to villages with dissimilar levels of education. The implementation of the model in larger and more diverse samples could add confidence to the belief that both electrification and education help retain people in rural areas.

NOTES

Chapter Three

1. I am indebted to J.R. Udry, Betty Cogswell and Alfred M. Field for useful suggestions during the planning and analysis phases, and to Philip Gallagher for computer assistance. All of the above are at the University of North Carolina. I also express my deep gratitude to Vincent Connolly, Mariano Useche and Guillermo Mora for valuable contributions during the planning, data collection and analysis, and computer stages of the project, respectively. Finally, I am grateful to the eclesiastical and civil authorities of Villa Gomez and El Penon for making possible the realization of this project.
2. Although the rate of growth of the cities in Colombia has recently slowed, this does not mean that the absolute number of migrants or the rates of emigration from rural areas have been reduced, as evidenced by the growing numbers of out-migrants from the towns examined in this study.
3. Cundinamarca is a large state or province surrounding the Federal District of Bogotá, the capital and largest city in Colombia. ED.
4. Although Villa Gomez also had an electrical generating plant, it was often in need of repairs when operating, and it only provided electricity for three hours per day, exclusively for household use and street lighting.
5. The usual procedure is to assign 0 to one town, 1 to the other. But the results are unaffected. ED.
6. This suggests the variable definition above should exclude the words "to the destination area," which would have been very difficult to operationalize in any case. ED.
7. Presumedly "after 1976" should be added. ED.
8. This minisurvey also served as part of the training of the students and teachers who were to carry out the actual survey later.
9. In Villa Gomez this included nine households within a fifteen mile walking distance from the center of town.
10. The question was: "Are you satisfied with the level of education attained by children in this town?" ED.
11. The percentage of population below age 15 was 35.4 in El Penon and 42.0 in Villa Gomez, implying a lower fertility level in the former.
12. In the last columns two years are considered together because, in data processing, people who had left in the previous year (1979) or less at the time of the survey (December, 1980) were classified together.
13. Note that the numbers of both in- and out-migrants shows an increasing tend over time, especially in Villa Gomez. Many undoubtedly were return migrants, which were identified in the survey questionnaire. ED.
14. The question was simply whether the child was enrolled in school, not actual attendance in the past week. Note that percentages of children enrolled in school in 1980 were generally 75 or higher in both towns for ages 8 through 16, but surprisingly not higher for ages 17-19 in Villa Gomez (with the complete high school). However, attendance rates at *earlier* ages were as high or higher in Villa Gomez (from age 6 through age 15). ED.
15. The question was, "How much income per month does a household like yours need to sustain itself here?" ED.
16. Clearly the rate of purchase was low and fairly constant in Villa Gomez, while it accelerated dramatically in El Penon starting in 1976. By 1980, there was only one item that more than 10 per cent of the households had in Villa Gomez, while in El Penon more than a third of the households had four different items. The difference is extraordinary. ED.
17. Presumably it would have had to be collected from former neighbours and would not have been reliable. ED.
18. The household income figure used was that perceived as necessary for the household by its head. (See footnote 15.)
19. The probabilities for those with relatives are not graphed because the great weight of the relationship variable tends to obscure the importance of electrification on the retention of population. The probabilities of out-migration for the 15 to 19 age group are also not depicted graphically because of the generally low levels of significance of the coefficients.
20. This, of course, may be partly due to the fact that there are good possibilities that Villa Gomez will be electrified in the near future.
21. The author did not specify age used for students. ED.
22. Note that a higher per cent of out-migrant households in later years was involved in coffee production in El Penon, where coffee production was larger. However, recall that the income figures still appeared similar in 1980 for the two towns. For example, one such influence may have been the increase in coffee prices experienced between 1976 and 1980.

DEMOGRAPHIC IMPACTS OF RURAL DEVELOPMENT RELATED TO AN IRRIGATION PROJECT

Pramote Prasartkul
Thavisak Svetsreni
Chakratit Dhanagom
Anthony Pramualratana[1]

To achieve greater social and economic development, Thailand implemented four national development plans between 1961 and 1981. During the period under the first three plans (1961-1976), the Government mobilized approximately U.S. $15 billion from foreign and domestic sources to finance various public development programmes and projects, including infrastructure improvements (roads, electrification, irrigation), education, health, agriculture, and industry.

As the facts of rapid population growth and its effect on slowing the pace of social and economic development became recognized in the 1960s, Thailand adopted an official population policy in 1970.[2] The policy aimed at reducing population growth by means of voluntary family planning. Since then a population policy has been included with other social and economic policies in every national development plan. Unfortunately, the population and socioeconomic plans have not been fully integrated, and though many development projects have intrinsic value, they have been undertaken without resort to an overall coordinated plan.

It is widely accepted that development programmes not directly involving demographic objectives can still have important demographic impacts. Unfortunately, existing knowledge about interrelationships among development and population factors is limited, partly explaining why policy-makers and planners fail to take into account demographic consequences in their social and economic programmes.

Population impact analyses of infrastructure development such as electrification, roads, and irrigation are of special importance for developing countries like Thailand. Universally needed anyway, infrastructure also provides a base for other developmental activities that follow. One of the main activities that infrastructure development can help to effect is an increase in agricultural production, which also contributes to overall development (including a net resource transfer to the nonagricultural sector). We propose here to examine the population impact of one type of infrastructure, an irrigation project.

The present Thai Government emphasizes the policy of elevating the living standard of farmers and declared 1979 the farmers' year. Consequently, emphasis has been put on irrigation projects, which have an important role in improving the agricultural economy by providing a dependable water supply.

An irrigation plan also was included in the Fourth National Economic and Social Development Plan (1977-81).[3]

Irrigation inputs operate indirectly through a group of intermediate factors to affect demographic variables. An irrigation project introduced into an area induces social and economic changes at the community and household level, which in turn generate demographic responses among individuals. Thus, population impact analysis involves multiple levels of causal linkages: between the development input (irrigation) and socioeconomic changes at the community level, and between those community changes and subsequent household and individual responses. Methodological problems also exist, such as multicollinearity between irrigation and other development efforts, interrelationships among socioeconomic changes at the community level, and relationships among population variables. Because of the theoretical and methodological complexity, population impact analyses have rarely been undertaken.

THE DEVELOPMENT PROJECT UNDER INVESTIGATION

For this study, the large Lam Pra Plerng dam and irrigation project in Northeast Thailand was chosen as a representative development project for which the demographic consequences could be investigated. The dam is located in Nakorn Ratchasima (or Korat) province, about 60 kilometres southwest of Korat city and 250 kilometres northeast of Bangkok[4] (Figure 1). The irrigation project was initially constructed to provide water to agricultural areas during the dry season from November to May and to control floods caused by heavy rain during the monsoon season from June to mid-October.

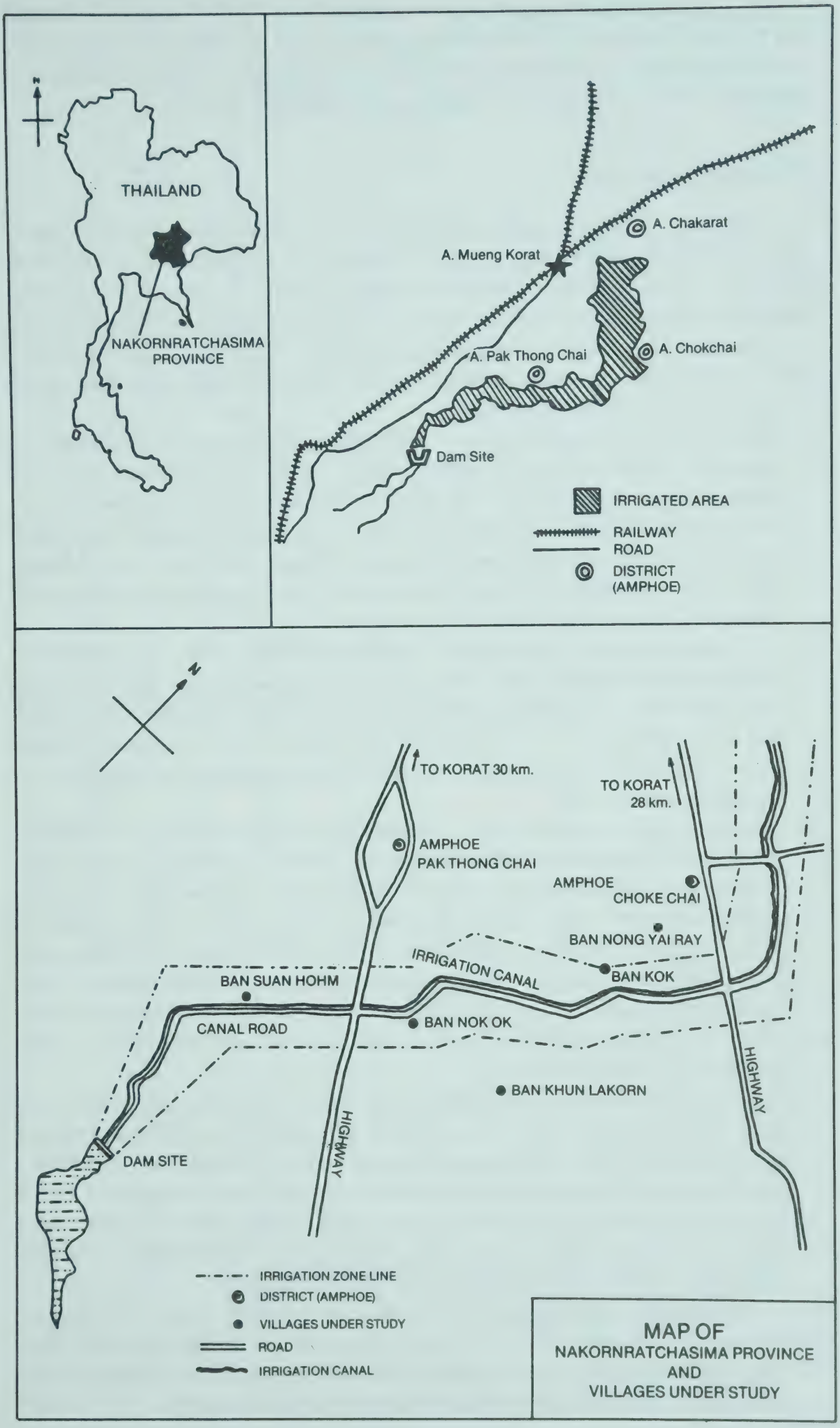
The population of the project area has been increasing rapidly during the past two decades. According to a 1960 estimate, the population was 7,700[5], while in 1972, project authorities estimated it to be 35,000[6]—an increase of 14 per cent per year.

The main reason for choosing the northeastern region was because levels of fertility and mortality are still relatively high and changes would be easier to detect. The northeast, locally known as "Pak Isan," is situated on a large plateau scattered with bamboo forests, rice paddies, cotton fields, and prairie. Rivers in the region run east to west. During the monsoons the waters overflow the river banks and fertilize the surrounding area. In times of drought, they dry up and the surrounding areas are parched and cracked from the heat of the sun. Because of its geographic situation, the Isan region is very vulnerable to the weather. Frequently troubled by drought and floods and resulting low crop yields, the people have trouble achieving a standard of living comparable to that in other regions. This has led to high out-migration.

THEORETICAL APPROACH AND HYPOTHESES

Research Goals

Irrigation projects are among several rural developmental activities in Thailand designed to elevate agricultural performance. They do not have demographic objectives. However, a development activity such as an irrigation



MAP OF
NAKORNRATCHASIMA PROVINCE
AND
VILLAGES UNDER STUDY

project may have important impacts on demographic variables as well as social and economic effects. In this research, we attempt to study the effects of an irrigation project on demographic behaviour through changes in social and economic variables at the community and household levels.

Theoretical Approach

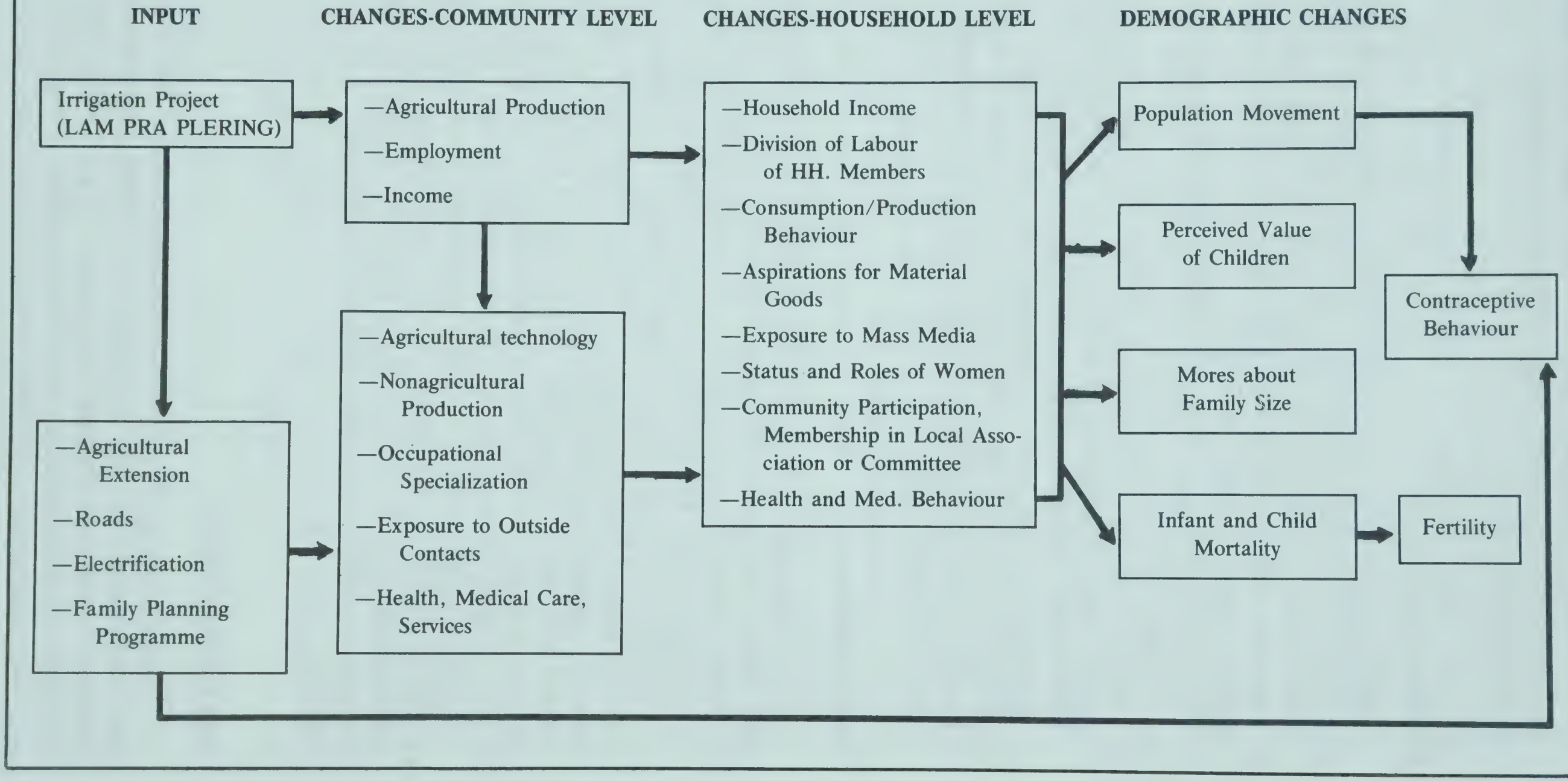
The conceptual framework attempts to show that changes in the dependent variable (fertility) caused by an independent variable (irrigation) work through a number of intermediate variables (Figure 2). Complexities in this theoretical approach are obvious because not all inputs are necessarily related to irrigation. However, it may provide a general notion of the ways in which the irrigation project (and related changes) affect the population, both at the community and individual levels.

1. *Changes at the community level.* With the introduction of an irrigation project into a relatively underproductive area, agricultural production should increase. By controlling the water supply, it becomes possible to double-crop. Two harvests, besides increasing production, also can be expected to increase the employment and incomes of farmers, raising their standard of living. Also, the total amount of land in production can be expanded because of irrigation, adding even more to production.

   Accompanying the irrigation project was the construction of an all-weather road, allowing easier transport of goods and people and increasing trade with other villages and towns. In addition, dam construction is often tied to electrification which, combined with increases in income, may generate new investment in agricultural technology and resource transfers to the nonagricultural sector.[7]
2. *Changes at the household level.* Household changes related to the effects of irrigation programmes are wide ranging. Changes in the community such as those described above can result in higher household incomes. Increased division of labour and changes in productive and consumptive behaviour occur, often culminating in the desires (and possibilities for fulfilling the desires) for more material goods, more education and/or exposure to mass media, and more travel. The greater prosperity of the community increases demands for improved health and social services, and may lead to better family and individual health.
3. *Demographic changes* Improvements in health conditions lower infant and child mortality rates. With the reduction of mortality, traditional forms of old age security may be replaced by newer forms. Parents may feel that a smaller number of well-educated children with the means to acquire a higher income would offer better security to them than a large number of uneducated children. Though there is a time lag, a decline in mortality trends eventually results in a decline in the desired number of children.

   Aspirations for material goods such as a television, radio, motorcycle, refrigerator, or gas stove, or for better agricultural implements and more land, also can contribute to changing attitudes toward family size because such goods can be acquired more easily by a small family.

FIGURE 2
CONCEPTUAL FRAMEWORK



For all of the above reasons, it is expected that an input such as an irrigation project would cause a change in familial attitudes and behaviour toward family size.

Working Hypotheses

Specific hypotheses concerning demographic changes include the following:

1. Irrigation would both slow the rate of out-migration from the irrigated area and increase the rate of in-migration from other, non-irrigated areas.
2. The health and sanitation of the population in the irrigated areas would improve, resulting in lower mortality.
3. Female labour force participation would increase because of an increase in productive activity.
4. The perceived cost of children would tend to increase. With higher social and economic development, parents would have greater expectations for their children (such as higher education and better health). As a result, the value of children as farm labour in irrigated areas would decline.
5. Because costs of children would increase and benefits decrease, we would expect a higher rate of contraceptive practice in irrigated areas, with the outcome of lower fertility.

Research Methods

In order to test the above hypotheses, this study originally proposed to use both sociological and anthropological approaches. Because of the difficulty of obtaining reliable time-series data on the newly irrigated communities, our research was designed as a combination of matched perspective and case control studies. The areas within the irrigation project were treated as the experimental areas and those nearby but outside the irrigation project as the control areas. We selected experimental and control areas adjacent to one another because we wanted to keep other developmental inputs at the same level as much as possible. We felt that the anthropological study would be very useful in illuminating development and demographic changes. We also felt that participant observers could describe these changes more clearly and give them a more human dimension than could dry, statistical research. Originally, the anthropological study was to serve as a basis for a larger household survey. However, as will be explained, the larger survey was not done for financial reasons.

DATA COLLECTION

Construction of the Lam Pra Plerng irrigation dam was initiated in 1964 and completed in 1968. However, farmers in the irrigated areas only began to use the system in 1970 when the main canal and water distribution system were completed. In this study, the year 1970 is considered the year that demarcates pre- and post-irrigation periods.

Anthropological Approach

We selected five villages, three irrigated and two nonirrigated, for the initial study. A researcher was assigned to each village to collect information on developmental and demographic variables in periods both before and after irrigation. A unique characteristic of this project is the application of the anthropological approach for the collection of extensive information on population change and development in the areas studied. Each researcher stayed for three months in the respective village and observed and interviewed villagers.

The specific aims of the anthropological field work were:

1. To test hypotheses set forth in the research project.
2. To develop new population/development hypotheses that could be tested by the household survey data in the next phase of the study.
3. To establish a greater understanding of village life, especially in the areas related to demographic and development variables. This would facilitate the development of structured questionnaires and survey methodology to be used in the next phase of the study.

An anthropologist's method of data collection and analysis is normally to reside in a village and observe behaviours for an extended period of time. The resulting statements and conclusions made by anthropologists are sometimes criticized as lacking in generalization and subject to individual interpretation bias.[8] To safeguard our research from these pitfalls, we modified the anthropological approach to facilitate its integration with the sample survey method by: (1) increasing the number of communities to be observed; (2) shortening the period of stay in the communities; (3) using sampling to select communities to be observed; (4) sending our trained researchers instead of professional anthropologists to stay in communities; and (5) providing researchers with the conceptual framework and guidelines to acquire adequate data. These modifications enabled us to collect comparable information from several villages within a much shorter time span and to avoid individual interpretation bias.

About a month before the field work, we recruited five researchers trained in demography, anthropology, and research methodology. We gave them the background of the research project and brought them to visit the study sites to familiarize themselves with the village lifestyle. Because they were not professional anthropologists, our researchers needed close supervision throughout the fieldwork. We set the working schedule so that the researchers in the field and the project investigators were able to meet together for field supervision once every two weeks. The rotation of visiting allowed the researchers to stay in the villages at least four weeks during each working period. The research investigators visited the villages once every four weeks.

Use of Key Informants

In order to determine different perspectives on village life in each site, we spread our informal interviews over three different age groups. The older males (over age 45) were current or previous *Kam Nan* (district headmen) or *Pu Yai Ban* (village headmen), long term residents, and traditional doctors.

The older females were either wives or former wives of the older men or long-term residents of the village. The middle-aged informants (aged 30-44) were agricultural and nonagricultural farmers, wage workers and their wives. The young group consisted of wage workers, temporary or seasonal migrants, husbands who reside matrilocally, and their wives. Four men and four women in each age group were chosen for interviews in each village.

We chose the informants in the older group because we wanted relatively detailed background information about village life before the construction of the irrigation dam, as well as about social norms and values in the village. Because most respondents in the oldest age group were not economically active, for our middle-aged group we chose informants who could provide detailed information about their agricultural and nonagricultural occupations. For the young group, we assumed there would be a higher frequency of wage workers (persons with no land of their own who hired out their labour) as well as a high frequency of seasonal migrants. There also would be more newly-weds, and since a majority of marriages take the form of matrilocal residence, such persons (husbands who reside matrilocally) could be good informants because they could identify certain values and norms different from those of their own village (if they came from another village).

For the oldest group, our interview focused on the history of the village before dam construction. The middle-age group was interviewed about general changes in households and the community as well as demographic changes. While the young group was asked about the same things, more emphasis was placed on temporary and seasonal migration and changes in family size norms, the perceived value of children and so forth.

Village Censuses

In each village, a census was undertaken. A total of 508 census forms were completed in the five villages. These provided data on village size, trends in births and deaths, and whether migration was in or out and temporary, seasonal, or permanent. The sizes of the villages were as follows:

Non-irrigated villages		Irrigated villages	
Khun Lakorn	53 households	Suan Hohm	97 households
Nong Yai Ray	70 households	Nok Ok	178 households
		Ban Kok	110 households

The data from the completed census forms was manually processed into separate tables by six research workers at our Institute. Problems encountered were minimal except where some information was missing. Because the sample was small, there were considerable difficulties in doing any real statistical analysis, but the goal was only to get an overview of the demographic changes tied to irrigation in order to generate specific hypotheses to be tested in a larger study expected later.

THE SAMPLE VILLAGES

Three villages in the irrigated zone were selected to represent the experimental areas: (1) Ban Suan Kohn[9] (Tambol Toom, Amphoe Pak Thong Chai), (2) Ban Nok-Ok (Tambol Nok-Ok, Amphoe Pak Thong Chai), and (3) Ban Kok (Tambol Plub-Pla, Amphoe Choke-Chai). All now have water for agricultural use year-round. The degree of benefit each gains from the irrigation project, however, varies according to geographic factors, such as the distance from the dam site. Common benefits from the irrigation project are flood control in the monsoon season and a supply of water in the dry season. The Lam Pra Plerng irrigation project has raised productivity in the regular farming season and enables farmers to have a second crop in the dry season, which consequently has increased their income and standard of living.

Villages in the Irrigated Zone

1. *Ban Suan Hohm*

Among the five selected villages, Ban Suan Hohm is closest to the main canal and only 10 kilometres from the dam site. The settlement pattern of the village is characterized by a compact cluster of households surrounded by rice fields (similar to the general pattern of settlement in the northeastern region). On our first visit to the village, we got the impression that the village had long been rich in natural resources because of the large numbers of big trees. We noticed several huge mango trees that we later learned were more than one hundred years old. The village was covered by orchards as well as a variety of fruit trees such as mango, jackfruit, and coconut on both sides of the river. Village prosperity was confirmed by some key informants. Ban Suan Hohm differs from the majority of villages in the region in that it has never had a serious water shortage. Before the irrigation project, villagers used water from a small stream that originates in the western mountains and passes through the village.

However, before the irrigation project, only single-crop cultivation in the rainy season was possible, and the village suffered from flooding almost every year. (Besides rice paddy production, villagers cultivate sugarcane on the higher levels.) After irrigation, the flooding problem was solved. Because of the short distance from the dam site, the village receives an adequate water supply all year from both the Lam Pra Plerng irrigation canal and the natural river, Lam Sum Lye, which makes second cropping possible.

Some other infrastructure projects that were introduced into Ban Suan Hohm following the irrigation project included agricultural extension services, roads and electrification. There were unpaved roads from the village to the district town long before the irrigation project, but the new roads built simultaneously with and along the main irrigation canal were in much better condition and facilitated contacts between the village and the district market town. The village has been electrified since 1977. Electrification was made possible by connecting an electric power line with the main power line leading to the headquarters of the irrigation project. The expense of the electrical connections was paid for by the villagers themselves.

Another development project directly related to irrigation is the agricultural extension programme of the Agricultural Promotion Division, Ministry of Agriculture and Cooperation, which introduced new agricultural technology, new high-yield rice stock, and new crops appropriate to local soil and climatic conditions. The villagers also were trained in marketing and accounting in order to deal with their increased productivity.

Because of irrigation, a good future seems assured for Ban Suan Hohm. There are now no floods in the monsoon season, enough water for the second crop in the dry season, new agricultural technology, easier accessibility to and from the market town, and the village has been lighted. The Lam Pra Plerng irrigation project changed Ban Suan Hohm into a highly developed village compared to nonirrigated villages in adjacent areas. Several informants perceived that the economic status of inhabitants was relatively high after the area was irrigated.

2. *Ban Nok-Ok*

Ban Nok-Ok is about 23 kilometres from the dam site and one kilometre from the main irrigation canal. Nok-Ok is nine kilometres from Suan Hohm and has similar environmental characteristics. The settlement pattern also is similar to Suan Hohm: a cluster of houses built almost roof to roof, surrounded by rice paddies. Before irrigation, the source of water was the Lam Sum Lye stream. There are about ten grocery stores, and the village seems fairly prosperous though a bit unkempt.

In the past, agricultural production was good due to regular seasonal rainfall. But toward the latter half of the 1950s, the village began to suffer flooding because of deforestation in the area. Rice and other crop production was seriously damaged. Deforestation also caused drought and water shortages in the summer. The climatic condition became unfavourable for agricultural activities.

In 1967, after the completion of the dam, the villagers of Nok-Ok started to benefit. Because the area was freed from floods, damage to crops was almost eliminated. The irrigation system, extended to this community in 1972, has made a tremendous difference in agricultural production by assuring a regular water supply.

3. *Ban-Kok*

Ban-Kok is the third village of our study in the irrigated area. It is approximately five kilometres from the irrigation canal and located at the edge of the irrigated area. Irrigated water reaches only two-thirds of its agricultural area and thus only one rice crop per year is possible. The presence of an irrigation canal, though, has enabled the village to increase its agricultural production.

Before the dam was built, rice was grown in two areas: on knolls (Na Koke) in forests northwest of the village and in low-lying areas surrounding the village (Na Lum). By farming the two areas, villagers protected themselves from disaster. If there were no heavy floods, both Na Koke and Na Lum crops would be spared, but if there were heavy floods, there would still be rice to harvest from the knolls. However, most knolls require extensive and very difficult clearing, and villagers must receive prior permission from the state to farm there.

The majority of Ban-Kok householders own a plot of land on which they produce rice. Before irrigation, floods often destroyed the crops and villages had to resort to other ways of making a living. They engaged in metal work (mainly producing knives for household use) and lime production, in conjunction with betel nut chewing, was a major secondary income. Burning wood to produce charcoal was one of the last resorts to make ends meet. Out-migration to municipal districts and town centres was frequent.

Irrigation brought many changes to Ban-Kok. During the pre-irrigation period, villagers had trouble subsisting because flooding often destroyed most of their crops. Knoll production of rice provided some insurance but not sufficient income. Now floods are controlled, agricultural production is greater, and garden crop production also has increased household incomes. Villagers of Ban-Kok are no longer forced to find work outside their village.

Villages Outside the Irrigated Zone

Two villages, Khun Lakorn and Nong Yai Ray, outside the irrigated zone were selected as control areas.

1. *Khun Lakorn*

In the past, villagers in Khun Lakorn grew rice only on knolls, and production was totally dependent on rainfall. The natural stream, Chiang Sa, runs past the village, and provides water for rice production. During the drought season, the water level of the stream dropped off but was still high enough to provide for some agricultural production. In the last seven years, however, the natural stream flows only during the rainy season and the water level is low, watering only paddy fields west and north of the village, leaving other areas dependent on rainfall. At other times of the year, the stream is dry.

When there is a shortage of water, villagers resort to some man-made springs, constructed years ago in the area. A small spring northeast of the village has been in use for the past 22 years, but it has become shallow and has not been used for seven years. Two other old springs can only be used in the rainy season. The decrease in water available from the springs (due to less rainfall) has resulted in lower agricultural productivity for many villagers.

Khun Lakorn has not been electrified, and there is no health centre in the village. There is one unpaved road.

2. *Non Yai Ray*

Nong Yai Ray is situated outside the irrigation zone, six-and-one-half kilometres by road from the irrigation canal. Nevertheless it receives many benefits from its proximity (two kilometres) to Amphoe Choke-Chai, including an extension of electric service into the village. The cultivation of rice in Nong Yai Ray depends on rainfall. During the dry season, various springs and small ponds dug by villagers, close to the village, are used.

The villagers suffer floods in the lower paddy fields and at times during the dry season there are severe droughts. At present, flooding has been controlled through the irrigation canals in the region, but the irrigation scheme

has almost dried up Nong Yai Ray's natural stream. Crops have suffered from this. As the water level of the Lam Pra Plerng dam is controlled, natural streams south of the dam rise and fall depending on the level of water in the dam. If the level is high, water is let out; if low it is not let out. Although some parts of Nong Yai Ray receive enough water from the irrigation scheme to grow some garden vegetables, there is not enough water to flow into the paddy fields for a second crop.

EMPIRICAL RESULTS

Village Populations

The 1975 and 1979 populations in the irrigated villages remained relatively stable in Suan Hohm and Ban Kok and increased nearly 10 per cent in Nok Ok (see Table 1). In every village, the percentages of population under 15 decreased somewhat, and the percentage over 65 nearly doubled, which may indicate that people are living longer. Median ages ranged from 15.3 (Ban Kok) to 21.0 (Suan Hohm) in 1975 and increased in all irrigated villages.

Population decrease was more apparent in the nonirrigated villages than in the irrigated villages. Khun Lakorn and Nong Yai Ray lost five and nine per cent, respectively. The irrigated villages have a higher median age and higher percentages of population in the 15 to 64 age group than do the non-irrigated villages, and a similar percentage under 15 (see Table 1).[10]

Population Movement

1. *Volume of migration*

Our initial hypothesis was that the irrigated areas would tend to experience net in-migration while the nonirrigated areas would tend to experience net out-migration. The data show that in irrigated villages that were agriculturally dominated (Suan Hohm and Ban Kok), the population during this five-year period showed only a slight change. An exception was Ban Nok Ok where the population grew by 85 persons in the five-year period, a 2.2 per cent annual increase. It should be pointed out that although Nok Ok is in the irrigated area, as were the previous two villages, it is not dominated by agriculture.

Population change in the nonirrigated villages is in the direction expected. Khun Lakorn and Nong Yai Ray lost population during the five-year period, losing 18 and 30 persons respectively for a decrease of 1.1 and 1.6 per cent. To acquire a more detailed and accurate analysis of population movement, we tested the accuracy of data on migration by putting all components of population change into the balancing equation (Table 2), and compared the results with the population in 1979 as enumerated. No figure deviates much from the enumerated figure, with a 2.6 per cent difference for Nong Yai Ray the maximum.[11] We observed net out-migration from every village except Ban Nok Ok; however, the magnitude of out-migration from irrigated villages was lower.

2. *Reasons for out-migration*

a. *From irrigated villages:* As Willis has stated in the opening paragraph of his *Problems in Migration Analysis:*

> The genesis of migration lies in dissatisfaction with the contemporary environment. Disparity of opportunity provides the main motivating force behind migration, whether this is to enjoy levels of living in terms of income or the physical or social environment. The importance of migration lies in its capacity to adjust resources and help to equate supply and demand.

A limited land area can support only a certain number of people.[13] In the irrigated areas, people may have maximized economic returns from the land through various developmental inputs, such as irrigation, fertilization, and agricultural extension, and there is an equilibrium between the productivity of the land and the size of the population. An increase in the population would become a surplus that would cause benefits per head to decrease, leading to out-migration to maintain the equilibrium. In the nonirrigated areas, the balancing process is different. Here there is a subsistence situation with a set of technological conditions lower than those in the irrigated areas. There have been few developmental inputs and, because of climatic changes and the drying of natural streams, partly because of the dam, productivity has actually declined. Reasons for out-migration from nonirrigated villages are the same as from irrigated ones; that is, to maintain the customary balance between the population and the land. The difference is that the population in nonirrigated villages has to decrease to compensate for the decreasing agricultural productivity. Thus, we find a heavy loss of population through out-migration in the nonirrigated areas.

Our initial hypothesis that the irrigated areas would have net in-migration proved to be incorrect. We discovered some probable explanations. First, the irrigation project brought about an agricultural breakthrough to the irrigated areas. As a result, the utility of land for agriculture was increased several times, and the value and price of land rose accordingly, closing off possibilities for relatively poor farmers from adjacent rural areas to migrate in. Second, the agricultural development that resulted from the irrigation project did not increase demand for labour. Double cropping requires more labour within a year, but this demand could easily be met by residents because considerable underemployment existed in the area.[14]

But why did Ban Nok Ok, also situated in the irrigated areas, experience net in-migration? This can be explained by the economic diversity in the village, which increased its capacity to absorb population. While almost 100 per cent of the families in the other two irrigated villages were crop farmers, only 50 per cent were so classified in Nok Ok. Some villagers raised pigs and poultry while others were merchants. Irrigation, in fact, did not have a very large effect on Nok Ok villagers because only half were engaged in any form of agriculture. The availability of water from the irrigation canal mostly affected washing, cooking, and animal husbandry, and only to a lesser

Table 1

CHARACTERISTICS OF THE POPULATIONS OF SAMPLE VILLAGES IN PERCENTAGES AND CHANGES BETWEEN 1975 AND 1979

	Irrigated Villages								
	Suan Hohm			Nok Ok			Ban Kok		
	1975	1979	Changes	1975	1979	Changes	1975	1979	Changes
Total	403	396	−7	767	852	+85	661	666	+5
Male	200	197	−3	398	430	+32	329	344	+15
Female	203	199	−4	369	422	+53	332	322	−10
Percentage < 15	31.02	29.04	−1.98	33.90	33.22	−6.80	45.08	42.64	−2.44
Percentage 15 to 64	66.75	66.67	− .06	62.32	60.92	−1.40	52.19	52.40	+ .71
Percentage 65+	2.23	4.29	+2.06	3.78	5.87	+1.99	2.72	4.95	+2.23
Median Age	20.98	23.72	+3.70	18.89	19.92	+ .40	15.32	16.59	+1.30

	Non-Irrigated Villages					
	Khun Lakorn			Nong Yai Ray		
	1975	1979	Changes	1975	1979	Changes
Total	336	318	−18	382	352	−30
Male	157	156	−1	191	162	−29
Female	179	162	−17	191	190	−1
Percentage < 15	42.56	36.79	−5.77	34.39	27.75	−6.64
Percentage 15 to 64	55.36	58.49	+3.13	60.32	64.74	+4.32
Percentage 65+	2.08	4.72	+2.64	5.29	7.51	+2.22
Median Age	16.86	18.70	+1.80	19.96	22.69	+2.70

Table 2

RESULTS OF BALANCING EQUATION*

Villages	Population 1975	Births	Deaths	Migrants In	Migrants Out	1979 Estimated Population	Difference	Percentage Deviation
Suan Hohm	403	35	7	6	47	390	−6	1.5
Nok Ok	767	76	18	71[a]	44	852[a]	NA	NA
Ban Kok	661	88	16	24	75	682	+16	2.4
Khun Lakorn	336	31	11	6	44	318	0	0.0
Nong Yai Ray	382	23	10	10	62	343	−9	2.6

* Births are estimated as the population under age 5 years in 1979 + persons under 5 years of age who died during 1975 to 1979.

[a] Estimated

NA — not applicable

extent agricultural productivity. When land for agricultural purposes is not a crucial factor in people's lives, obstacles to in-migration are weaker and this is why Nok Ok gained a relatively large volume of in-migrants.

b. *From nonirrigated villages.* Both villages outside the irrigated area experienced heavy out-migration, as hypothesized. This may be a reflection of a process found in most agricultural areas in Thailand that are still underdeveloped.[15] It is common to have a population surplus because of a high birth rate and dropping death rate. The relative deprivation of people in these villages is clear to them through exposure to mass media (radio and newspapers), from the improved transporation system, and from their friends who have migrated. Seeing no future in farming, young people who have any adventurous spirit are tempted to move away.

Although the control villages are situated outside the irrigation zone, it cannot be said that irrigation had no effect on them. Khun Lakorn is a good example of the migration effects of a development programme in a village outside but adjacent to the project areas. Sixty-one people of working age left Khun Lakorn during the ten years following the completion of the dam. On average, two per cent of the total population migrated out every year.

Changes in the availability of water for agricultural purposes may have influenced out-migration. A key informant at Khun Lakorn states:

> Ten years ago all that was grown in this village was rice. In earlier times (ten years ago), we grew rice on knolls. We depended on rainfall and on a nearby stream that flows through the village from the West. Chiang Sa was used by us all year round. The level of the water was about a meter high during the rainy season (April), this level decreased in November but was still enough for our uses all year round. Now, Chiang Sa stream does not flow all year round, the only available water is during the rainy season and that water is limited. The level of the water depends on the rains each year. If there is not much rain, there will be no water for the village; now the water level at its highest is only half a meter. At this height, it is only enough for the paddies in the west and the north side of the village, elsewhere the rice paddies depend totally on rainfall. Now, even when it rains the water level is low.

One purpose of the construction of the Lam Pra Plerng dam was to control floods. This has been successful and there are now no floods in the rainy season in either irrigated or nonirrigated areas. But, as a result it has also blocked the flow of water by natural streams to villages outside the irrigated area. This means that areas outside as well as within the irrigation area are affected by the dam. Controlling the water supply for the benefit of irrigated areas has had a negative effect by lessening the amount of water for areas outside the irrigation scheme. Without annual flooding in adjacent areas like Khun Lakorn, the land has not been as fertile as before. Therefore the control of water by the Lam Pra Plerng dam resulted in a deteriorating condition for inhabitants of Khun Lakorn by blocking their water supply.

The people in Khun Lakorn have not associated their problems with the construction of the dam as an inevitable natural change. One can imagine the tremendous social impact of the irrigation project in villages like Khun Lakorn, which is outside but adjacent to the irrigated area. Many villages less than ten kilometres away from Khun Lakorn are enjoying the benefits gained from the government irrigation programme. The villagers at Khun Lakorn see this clearly because they pass those villages on their way to the district market town, the provincial city, or Bangkok. Exacerbating the problem is the spread of a higher cost of living in irrigated areas, which affects those who live in nonirrigated villages, too, even as they are becoming less productive. For these reasons, it is not surprising to find adjacent nonirrigated villages experiencing heavy out-migration since completion of the dam.

Table 3

TOTAL OUT-MIGRANTS AND PERCENTAGES WHO SENT OR DID NOT SEND MONEY BACK HOME, 1975-1979

	Sent Money				Did Not Send Money				Total
Town	Total	Male	Female	%	Total	Male	Female	%	
Suan Hohm	17	6	11	27	46	25	21	73	63
Nok Ok	40	27	23	47	46	32	14	53	86
Ban Kok	33	17	16	47	38	18	20	53	71
Khun Lakorn	16	11	5	53	14	7	7	47	30
Nong Yai Ray	22	13	9	35	41	25	16	65	53

3. *Significance of migration*

Though young migrants move in search of better opportunities, there is not a severance of all ties between the family and the migrant. The migrants we studied kept a sense of belonging to their home village, and many send money back to their families. Each individual move is not a decision solely to attain higher individual incomes; migrants expect their families to profit from their improved incomes as well. Money sent back to the family is used for buying additional rice during droughts, household commodities, extensions or repairs to the house, emergencies, and for donations to the village temple. Table 3 shows how many migrants sent money back to their homes. The small number of cases is obvious and has limited our analysis.

Nevertheless, wide differences in the percentages across villages may reflect certain socioeconomic conditions of the villages. Ban Suan Hohm, for instance, has a low percentage of out-migrants who sent money back (27 per cent) as opposed to Khun Lakorn (53 per cent). These figures may reflect the different socioeconomic conditions and motives for migration. Suan Hohm out-migrants may not migrate with the intention of making more money for the family, or see the necessity of sending money back. Khun Lakorn out-migrants, on the other hand, may recognize an immediate necessity—because of population pressure on the land—to out-migrate to get money to help their families.

Mortality

The mortality rate in a small population is usually too low to collect enough cases to be analyzed meaningfully, and our study is no exception. Sizes of villages in our study ranged from 318 to 852, and the number of deaths from 1975 to 1979 ranged from eight in Nong Yai Ray to 18 in Nok Ok. Because of these small numbers, we could not perform much statistical analysis. However, we can present some suggestive findings.

1. *Differences in mortality levels*

We calculated crude death rates in each study village and found them below the national average of nine to ten per thousand in every village. This may be because of small sample sizes.[16] However, our intention was not to use these death rates to measure mortality but to compare mortality between irrigated and nonirrigated villages.

Death rates in irrigated areas were lower than in nonirrigated areas. Crude death rates per thousand in irrigated areas were 3.5 in Suan Hohm, 4.4 in Nok Ok, and 4.8 at Ban Kok, while in nonirrigated areas they were above 5 (5.4 at Nong Yai Ray and 6.7 at Khun Lakorn). It was possible to judge from our anthropoligical study, as well as the survey, that lower death rates in the irrigated areas resulted from better health conditions. A more meaningful indicator of the standard of health can be seen in the availability, usage of, and attitudes towards health facilities within each village.

2. *Health care facility use*

Suan Hohm villagers have a health centre that is two kilometres outside the village boundary. The road to the health centre can be travelled throughout the year, but it is still underused. This may reflect: (1) the degree of monetary prosperity of the villagers (and few illnesses), or (2) the villagers' attitudes toward the health centre. Though the health centre is only two kilometres away, many villagers in need of medical attention travel much farther to Amphoe Pak Thong Chai health centre or to Korat Hospital in Nakorn Ratchasima, even though services there are more expensive. Suan Hohm villagers prefer to go to Pak Thong Chai centre or Korat Hospital because they believe those facilities provide better treatment than the local health clinic. Their bypass of the local clinic also may indicate that they have enough money to buy what they perceive to be better service. The local health centre appears to be used by the villagers only for acquiring contraceptives and simple medication.

Ban Nok Ok is similar. Villagers prefer to go to Amphoe Pak Thong Chai health centre (three kilometres away) for most ailments, though a health centre is situated right in the middle of the village. The Nok Ok health centre had been in use for three years, but people use it only for fever and contraceptive pills. The average daily number of patients is only about six, though the centre provides services to eight other villages as well. If villagers are sick in Nok Ok they usually purchase medicine from the village drugstore. Some villagers go directly to the Pak Thong Chai health centre, while others go to private clinics in Pak Thong Chai.

In Ban Kok, the closest health centre is three kilometres from the village centre. For minor ailments, villagers purchase medicine from the local grocery store. Ban Kok has a good traditional doctor, and the Amphoe health centre has trained him in such things as modern methods of childbirth. Still, in cases of more than minor illness, villagers go to Korat, a travel time of 30 minutes by hired car for a cost of about 300 Baht.[17]

Villagers of Nong Yai Ray have the services of two traditional doctors, but they are rarely used. The health centre in Amphoe Choke Chai is only two kilometres away, so ailing villagers frequently travel there.

In Khun Lakorn, the nearest health centre is three kilometres away at Nong Sala and the journey can only be made on foot. If a villager is sick and in need of help, others have to carry him there. The health centre is only used for the acquisition of contraceptive and fever pills. For more serious illness, the bus trip to Pak Thong Chai takes about two hours while the trip to Korat takes four hours. The traditional doctor at Khun Lakorn has received training from the Amphoe health centre and has been given scissors for cutting the umbilical cord after childbirth (replacing the old method of cutting with sharp bamboo instruments). A grocery store opened in Khun Lakorn in 1980 and sells some medicine.

We found that proximity to the irrigation area, as well as to an urban area, determine to a large extent the degree of knowledge of health practices, availability of services, and subsequent health standards of the villagers.

3. *Causes of death*

In Table 4, we divide the causes of death into six categories based on the villagers' statements about the causes of death among their relatives. Villagers do not have a high level of differentiation among causes of deaths so the categories "other" and "unknown" contain a high proportion of deaths.

The first listed cause of death, "fever" or ***kai*** must be understood within its context of village society. "Fever" as perceived by the villagers has a certain relationship to fire. If a person's forehead feels hot, then he has fever or ***kai*** without differentiation as to what is causing the fever. When a villager is sick, peer and kin consultation is more prevalent than direct, immediate medical consultation, so people may not know the diagnosis of most illnesses. "Fever" accounted for 34 per cent of deaths in irrigated areas and 40 per cent in non-irrigated areas.

A complication of the digestive system due to an inadequate diet, from the wrong kind of diet or from dirty water, was prevalent only in the nonirrigated area. There were no reported cases of gastrointestinal infections in the irrigated villages while three cases were reported in the nonirrigated villages. This may be because of the source of water. The irrigated areas, in closer proximity to the irrigation canal, have much cleaner water than the nonirrigated areas. The nonavailability of water has a direct effect on the degree of sanitation in a village and as a result, the sanitation levels in Khun Lakorn and Nong Yai Ray are below those of the irrigated villages. In the irrigated villages, the availability of clean water has permitted the construction of toilet facilities for all.

Table 4

CAUSE OF DEATHS WITHIN IRRIGATED AND NONIRRIGATED VILLAGES, 1970-79

	Irrigated Areas						Nonirrigated Areas			
	Suan Hohm		Nok Ok		Ban Kok		Khun Lakorn		Nong Yai Ray	
Causes of Deaths	1970-74	1975-79	1970-74	1975-79	1970-74	1975-79	1970-74	1975-79	1970-74	1975-79
"Fever"	3	1	8	8	4	5	7	4	4	2
Gastrointestinal	0	0	0	0	0	0	1	2	0	1
Homicide	3	1	0	1	0	4	0	2	2	2
Accident	1	2	1	4	0	3	0	0	2	2
Other	3	3	0	0	0	0	1	3	0	2
Unknown	2	0	9	5	4	4	4	0	0	1
Total	12	7	18	18	8	16	13	11	8	10

Another factor contributing to higher rates of gastrointestinal disease in the nonirrigated areas may be differences in diet. In Khun Lakorn, for example, hunting and gathering of food is still widely practiced. Frogs, insects and different varieties of animals are eaten along with wild berries, and noncultivated vegetables and fruits. Villagers in irrigated areas buy most of their food from the market.

During the last five years, 10 persons were murdered in the villages under our study. There appeared little differences in homicide rates between the two types of villages. We did not acquire data as to motives for these murders, but we can say that murder is not uncommon in village society because of inadequate law enforcement. There is a bit of a "wild west" mentality because if a person kills for what other villagers see as a good cause, he is considered a good person.

The irrigated villages seem to have more accidents than nonirrigated villages. In the 1974-79 period, there were nine deaths by accident in the irrigated villages while in Khun Lakorn there were none. There were only two in Nong Yai Ray. This may indicate a higher degree of modernization as well as increased contact with the external environment outside the village. The introduction of the all-purpose machine and its use mainly in the irrigated villages, has resulted in deaths along the highway.[18] Villagers drive their homemade trucks along the road and many have been involved in accidents with pedestrians.

Thus, the irrigated villages experienced lower deaths related to sanitary and health conditions, but they experienced a higher number of deaths related to a higher degree of mechanization and technology.

Fertility

An important goal of the Thai Government is to reduce the country's fertility rate. This policy was initiated in the Third National Economic and Social Development Plan. Our aim in this section is to investigate the relationship between irrigation and fertility reduction. We tested the hypothesis that through development, irrigated areas would experience lower fertility than the nonirrigated areas.

1. *Differences in fertility levels in study areas*

From our census, we found that fertility, as measured by the average children born per mother, was lower in the irrigated villages than in nonirrigated areas. The average number of children ever-born (CEB) in the irrigated villages was 3.4, while the average CEB in the nonirrigated villages was 4.3. The average number of living children (LC) was 3.0 in the irrigated villages and 3.4 in the control villages. If we compare the number of living children with the number of children ever-born, we find that in the irrigated villages, the mean number of children not surviving was 0.4, while in the nonirrigated villages it was 0.9. This suggested a higher level of mortality in the control villages, along with higher fertility.

In Table 5, we present the number of children ever-born to mothers in different age groups in irrigated and nonirrigated villages. The data confirm our hypothesis of lower fertility in irrigated villages. In the age group below

Table 5

AVERAGE NUMBER OF CHILDREN EVER-BORN AND CHILDREN SURVIVING IN IRRIGATED AND NONIRRIGATED VILLAGES

	Irrigated Villages								Nonirrigated Villages					
	Suan Hohm		Nok Ok		Ban Kok		Total		Nong Yai Ray		Khun Lakorn		Total	
Age	CEB	LC	CEB	LC	CEB	LC	CEB	LC	CEB	LC	CEB	LC	CEB	LC
15-19	1.00	1.00	0.50	0.50	0.00	0.00	0.67	0.67	*	*	0.00	0.00	0.00	0.00
20-24	1.67	1.67	1.07	1.07	1.40	1.20	1.34	1.31	0.50	0.50	1.33	1.33	1.00	1.00
25-29	1.92	1.92	2.09	2.09	2.40	2.33	2.23	2.16	2.58	2.08	2.17	2.17	2.44	2.11
30-34	2.80	2.80	2.61	2.61	4.60	4.40	3.21	3.02	4.00	3.14	3.29	3.14	3.64	3.14
35-39	3.80	3.50	2.82	2.82	5.58	5.33	4.06	3.56	4.50	4.00	4.45	3.90	4.46	3.92
40-44	4.36	4.00	3.39	3.39	5.62	5.38	4.51	4.02	5.83	4.33	5.43	4.43	6.46	4.38
45-49	4.29	3.86	3.80	3.80	6.33	5.08	5.10	4.21	7.00	5.78	9.17	6.83	7.87	6.20
All ages	3.01	2.85	2.66	2.66	4.18	3.85	3.39	3.04	4.20	3.38	4.13	3.51	4.29	3.44
No. women	67		146		80		292		40		45		85	
Age standardized							3.10	2.80					3.75	3.10

30, fertility levels were similar, as would be expected. Just beginning their families, married couples in this age group have less tendency to practice contraception. But starting from the age group 30 to 34, fertility differentials between the irrigated and nonirrigated villages begin to widen, with the irrigated villages having a CEB of 3.2 and the nonirrigated villages, 3.6. Suan Hohm and Nok Ok may have reduced their fertility as compared to Khun Lakorn and Nong Yai Ray. The CEB of 4.6 in Ban Kok seems to be a deviant case.

In the last age group of 45 to 49, when women have reached their completed family size, we see that the average number of children ever-born in the irrigated villages is 5.1, substantially lower than the 7.9 in nonirrigated villages.

One may argue that the difference in mean CEB between the two areas was affected by the different age structure of the two populations. We tested this through age standardization. (The distribution of married women in the 1970 population census was used as the standard population.) The standardized mean number of CEB in irrigated areas was 3.1 compared to 3.8 in nonirrigated areas. The average difference of 0.7 child per mother confirms the lower fertility in irrigated areas.

2. *Factors determining fertility differentials*

a. *Family planning.* The prevalence of family planning in irrigated villages can be deduced from information provided by key informants and from our research workers who lived in the villages temporarily. For example, our resident researcher in Ban Suan Hohm stated that:

> . . . in brief then, in Suan Hohm the contraceptive pill and injection are very popular. There are some houses who have set up a small grocery store that also sells contraceptive pills. From observations of rubbish piles of each household, I have come across empty packets of contraceptive pills in most piles of rubbish.

A report from our researcher in Nok Ok identifies norms about low fertility.

> Some men have gotten vasectomies, and some women have received sterilization because they saw their friends going to receive them and decided to go along. They wanted to limit their family size like the others who have gotten sterilized. Presently, if a couple has a lot of children or many children in a short space of time, he/she tends to be ridiculed. A lot of children is seen as shameful and uncontrollable behavior; when people report their births to the registry officials they are afraid that the officials also will ridicule them.

The set of conditions and attitudes described above may be contrasted with the attitudes of people in the nonirrigated villages:

> Villagers in Nong Yai Ray have been aware of family planning only in the last five years. At its introduction, villagers felt that contraception was a sinful act; they thought that people nowadays are

not afraid of committing a sin, maybe because there was no real live baby involved yet. Villagers still believe that contraception is a sin, but not as bad a sin as the practice of abortion.

The situation in Khun Lakorn concerning family planning is reported by our researcher as follows:

> Before the establishment of the Lum Khao health centre, villagers of Khun Lakorn had no idea about family planning whatsoever. Childbirth was an occurrence that nobody in the village sought to alter, including infant and child mortality. Mortality occurring at a higher rate affects the decision by married couples to have another child. Haenk Chun Jungreed of Khun Lakorn told me that:
>
> > "I think that I want to have many children in case one of them dies. If I have only one or two children and they die, I will then have no children."
>
> At this time, Haenk had no children. There also is a local belief that if you take the core of a coconut and boil it, its consumption will prevent pregnancy. This was ineffective and so villagers in Khun Lakorn continued to have births till the onset of menopause.

It seems, then, that family planning prevalence is more widespread in the irrigated villages than in the nonirrigated villages. Norms concerning family size differ and the belief in smaller families has influenced people in the irrigated villages to accept the practice of contraception. But in the control villages, large families are still valued and contraception is often viewed as sinful.

b. *The value of children.* Why is family planning practiced in one area and not in another? Some differences may be because of health inputs, proximity to the health centre, and access to information. However, in the irrigated villages there exists supply and demand, but in the nonirrigated villages there is supply without demand. The Nong Yai Ray health centre, for example, is underused in terms of contraceptive services (as well as other services), reflecting little interest in limiting or spacing births.

Small family norms in the irrigated villages may exist because of changing values with respect to children. With increasing development and modernization, people in the irrigated areas have adjusted their fertility behaviour. Without this, they would have been handicapped in their efforts to take advantage of the economic opportunities afforded them by the dam construction. The desire to get ahead, and the possible realization of that desire, caused a modification of reproductive behaviour. Villagers have come to see that the old fertility standards of a large family hamper them in their efforts to get ahead. "Too many children, too little money" was a saying prevalent in the irrigated villages.

But for villagers struggling to maintain a livelihood, the concept of family limitation was not of major significance. In the nonirrigated areas, child labour

in agricultural activities is still highly valued. Our Khun Lakorn researcher informs us that:

> Boys tend buffaloes, and if they meet any small game during this time they use their sling shot to hunt. If they come across any vegetables, they pick them to take home. From the age of ten, boys are experienced hunters, especially in hunting snake, which is a delicacy in the area.
>
> Girls eight years and more are already experienced in house chores, which are seen as preparatory for all good housewives. In the morning, girls (ages 8 to 14) cook rice, clean house and fetch water. They remain at home while others go to the fields and take care of the very young children.

The nearly self-sufficient lifestyle of these villagers can be seen in their food consumption. Crops grown for home consumption during the rainy season include pumpkin, squash, luffa, soya bean, and mung bean. During the dry season, villagers gather wild crops, such as bamboo shoots and amaranthus. Vegetables available throughout the year include hot peppers and kratin (genus leucaena, the lead tree). Animals hunted during the rainy season include frogs, paddy crabs, and bull frogs. Sand lizards, cobras, rabbits, spiders, turtledoves, and quails are hunted throughout the year.

Subsistence agriculture may be defined as a level of living derived from agricultural production on which one can barely exist and which therefore permits no surplus to be invested, sold, or otherwise used to improve the standard of living.[19] A family must use all possible labour inputs to provide for such basic necessities as food, shelter, and clothing. At this level of existence, where all possible labour inputs are used, children are usually associated with "extrinsic" values,[20] *viz.*, economic benefits, security, and continuance of the family name. This does not mean that "intrinsic" values such as love, happiness, and companionship do not exist in the nonirrigated villages, but that child labour is crucial in very poor households. Above this subsistence level, the utility of children changes with household economic conditions, and the concept of family limitation takes on meaning.

c. *The costs of children.* The cost of childbearing is higher in the irrigated rather than in the nonirrigated villages. Food expenses are high because food is purchased at the market and not hunted or gathered. Children are dependents longer primarily because they stay in school longer. Compulsory education pulls children from the fields, and closer contact with educational authorities makes it more difficult for parents to keep their children at home tending their paddies. The cost of childbearing also is quite high as villagers have come to use the Amphoe Health Centre, Korat Provincial Hospital, and private clinics for childbearing and most medical treatment.

Parents in irrigated villages feed their children mashed rice, bananas, oranges, etc., as well as breast and canned milk. Infants wear store-bought clothes, along with gloves and socks to prevent them from scratching themselves. Villagers from Suan Hohm are influenced by what they see on sale in town for their babies. They buy many items such as toys, baby stools with wheels (used to teach children to walk), and steel-framed cradles meshed with mosquito netting. Parents send both sons and daughters to get more education (grade six and above) if they desire. Thus, the cost of child rearing, including medical costs, clothing, toys, and education, is fairly high in the irrigated villages, whereas most of these costs are not incurred in the nonirrigated villages.

In the latter, the cost of childbearing is almost nil. In most cases, a traditional birth attendant or granny midwife assists in the delivery, but sometimes just the expectant mother's relatives help out. In fact, no villager in Khun Lakorn has had a birth at Korat hospital. Children are fed local foods, such as mashed bananas and rice porridge soup, and there is a higher prevalence of breastfeeding. Older children watch babies so that mothers are free to tend the paddies and work around the house. There are no store-bought clothes for children in Khun Lakorn. Many infants and young children do not wear any clothes. Toys are made from local materials rather than bought: for example, villagers build a bamboo type merry-go-round that the baby holds on to when learning to walk, and cradles are made from an old bath towel tied to two house posts or trees when the mother is working in the field. Education is only up to the compulsory level, and during the harvest season teachers allow children to leave school early to help with the harvest.

d. *The status of women.* There are relatively few differences in sex roles in both areas, though with increasing modernization in the irrigated areas, a certain degree of role differentiation has arisen. With the advent of mechanization, men have taken on a more dominant role. Men use and maintain the all-purpose machines. This is an important beginning of role differentiation because the machine is used in many facets of daily village life. With men working in these areas, women have moved into the sale of produce and budgeting activities. Before mechanization, budgeting and finances were handled within the family unit with no specific division of labour.

Kamol, who studied village life in Tambol Sarapi (not far from our present study areas) in 1968, stated that there is not much specialization of labour between the sexes, and, as a result, no role incompatibility.

> Men and women both work in the paddy fields. There are some jobs that women do not do such as ploughing, clearing forest, cutting wood. Men also do not engage in tasks such as sewing clothes and ironing. Preparing food is considered a task for women, but if the housewife is away then the men also can do it. Another job that both husband and wife do is child-rearing.
>
> With the exception of separation of tasks mentioned above, it is found that there are no divisions of labour between the sexes in

Sarapi. This is due to the closeness of the family unit, which has also been observed in other areas of the country.

e. *Modernity.* Smaller family size norms were formed, to an extent, by exposure to external influences. With the increase in transportation and communication, villagers in the irrigated area are more able to compare and contrast differences between themselves and other villages or towns, creating a motivation to get ahead. Goals for social mobility begin to take shape with increased education of children. Information about family planning helps villagers see the benefits of a small family and to control fertility. All of this is tied to increased income. With electrification entering most villages in the irrigated area, the acquisition of household appliances, such as televisions, radios, electric rice cookers, refrigerators, etc., becomes common. A process of weighing begins to emerge between more children on the one side and more material goods on the other.

The nonirrigated villages lack all the amenities just described. They have poor transportation and villagers are concerned with the immediate problems of hand-to-mouth existence. As a result, no planning is undertaken, nor is planning possible. The economy is what we may term as a *self-perpetuated recycling economy*—a nonexpanding economy wherein the passage of time is seen in seasons and years, and the problems of survival are experienced daily. It is self-perpetuated because it can exist with little outside contact; it is recycling because in a sense what is taken from the land is given back, and taken again at the same rate.

3. *Conclusions about fertility differences*

We believe that the four interrelated factors described above, namely family size norms, value of children, status of women, and modernity, have influenced fertility in both areas. Irrigation combined with other developmental inputs has created a change at the community level in terms of productivity, mechanization, etc., and these changes in turn have affected and stimulated changes at the household and individual level with respect to family size norms. The process of multiple-cropping has increased income, and at the community level this has caused a change in family size norms through the changing value of children, status of women, and modernity. All these factors, accompanied by increased use of family planning, contribute to lowering fertility.

Because of the complexity of the interactions, we cannot single out any specific variable as the cause of the observed fertility reduction, but we believe irrigation, in combination with its related development inputs, has led the local economy to supply more than the basic needs, and has thus been a major factor in reducing fertility.

Of course, the two areas studied were to some extent different even before the establishment of the dam. River bank communities have, since ancient times, been more prosperous than frontier lands of the interior. A higher frequency of external contact along with more modernization is not unlikely in these areas. It is an irony that these communities, because they are located on a natural

waterway and are already better off than the interior villages, should secure the further benefits of an irrigation system. With the introduction of the irrigation scheme, socioeconomic differences that already were apparent have widened. Thus, the inequality that existed in the area has increased as a result of the irrigation scheme.

Unfortunately, we were not able to compile a census of the study areas prior to the completion of the dam. This is a major drawback to our research. If we had been able to do this, we would have been better able to judge the original differences between the villages, and thus we could have more accurately measured fertility before and after dam construction.[21]

SUMMARY

In our research project, we aimed to evaluate the impact of a large irrigation project on the surrounding population. The Lam Pra Plerng Irrigation Project in Nakorn Ratchasima Province in northeastern Thailand was selected as the study area. Our original plan was to collect data through an anthropological study implemented during the first year, and then use that data to design an extensive sample survey in the second year.

The chapter is concerned only with the anthropological study. Ours was not a conventional anthropological study, which deeply scrutinizes the culture, rites, and rituals of a population in a single area. Instead, we have attempted to apply the anthropological approach to the study of population by sending out trained researchers to stay in five villages for a period of two months in each village. The merits of this approach were that researchers who had stayed in the villages as participant observers acquired more information than would "strangers" (interviewers) who made only short visits. Each researcher conducted a census in the respective village. The resulting data, combined with interview information, was used to help explain population changes.

As expected, the irrigation project did seem to change ways of life of the population in irrigated areas. Before irrigation, these areas suffered flooding during the heavy rain season, while in the dry season the supply of water was not adequate for significant agricultural activities. With just enough rainfall, agricultural production was adequate to maintain a "moderate" standard of living. With inadequate rainfall—a more frequent occurrence—agricultural production was stifled to the extent that out-migration was necessary.

The aim of the irrigation project was to serve areas by preventing floods in the rainy season and supplying water to the paddy areas during the dry season. The first change in village life caused by irrigation was the introduction of multiple cropping in irrigated areas. The people who received benefits from the irrigation system were able to remain employed throughout the year instead of for only a few months. With multiple cropping, farmers had to change their habits to gain maximum benefits from the irrigation system. Mechanization was found to be one way that helped them use time more efficiently. The all-purpose machine became indispensable.

Other development projects followed from the irrigation scheme. An immediate by-product was a road along the main canal that links villages in the irrigation zone. The Ministry of Agriculture and Cooperation also promoted an agricultural extension programme to increase agricultural productivity. New crops and agricultural technology such as fertilizer and pesticides were introduced. Agricultural productivity per unit of area in the irrigated areas has increased tremendously. The income of farmers and the value of land also have increased accordingly. All these socioeconomic changes in the irrigated area led to a number of demographic changes as well.

We hypothesized that the irrigated areas would have net in-migration because irrigation would create better economic opportunities, which would attract migrants, or at least influence natives to remain. However, factors affecting migration were more complicated, and the hypothesis of net in-migration into irrigated areas was not confirmed. Increased land value in the irrigated areas was the main obstacle. The increased land value prevented farmers outside the area from purchasing land and discouraged those residing within the area from selling land. Demand for wage workers in the area also did not increase. Double cropping merely meant that farmers were able to work year-round and thus relieve underemployment in the villages. Therefore, while we were correct in hypothesizing that out-migration from irrigated areas would decrease, net out-migration from the nonirrigated control areas to the irrigated areas did not occur.

Our second hypothesis stated that health and sanitation in the irrigated areas would tend to be better than in the nonirrigated areas and would result in a lower mortality rate. Though it was difficult to gather reliable data on health status and causes of death, we did find that deaths from gastrointestinal illness were lower in the irrigated villages and accidental deaths higher.

We proposed that female labour force participation would tend to be higher in irrigated areas through an increase in productive activity. We found that the level of female labour force participation was not very different in the two areas, but there was a change in the irrigated area with regard to the nature of female participation. Before irrigation, the family worked together much like a total unit, with only small differentiation with regard to sex roles. With the advent of mechanization and resulting modernization, female participation in the labour force increased a bit, and more importantly, there was a diversification into new fields such as budgeting, marketing and organizing for the sale of produce.

We believed that the perceived cost of children would be higher in irrigated areas because, with greater social and economic development, parents would have higher expectations for their children (more education, better health, etc.). The value of children as farm labour in irrigated areas would also tend to be lower.[22] For these reasons we expected a higher rate of contraceptive practice in irrigated areas and a final outcome of lower fertility. We found that indeed the cost of children was higher in the irrigated villages. Childbirth, as well as child rearing, included many costs not found in the nonirrigated areas, such as transportation costs, hospital bills, medical expenses, store-bought clothing, children's play equipment, etc. Higher education was expected of the children, and this was costly too. With the increasing costs and decreasing economic utility

of children, contraception became more readily accepted among villagers in the irrigated areas. These changes occur in most developing areas and irrigation may have only accentuated the demographic changes. Population differentials between the irrigated and nonirrigated villages were caused by various developmental inputs in combination, not just any single one. Irrigation was only one among a number of factors contributing to the observed population changes.

It appears that irrigation was a major factor affecting the reduction of fertility in the irrigated villages. The average number of children-ever-born in the irrigated villages was lower than in the nonirrigated villages, and age-specific rates much lower above age 30. Health centres in the irrigated areas were more widely used for contraceptive services. For many villagers in the nonirrigated areas, the concept of family limitation was not comprehensible.

Though the irrigation scheme can be said to be a success in that it doubled agricultural production and increased the standard of living for the people within its boundaries, it widened the gap between the irrigated and the nonirrigated areas, already present before the irrigation scheme. This, we believe, caused an increase in the level of out-migration from the nonirrigated areas to other rural or urban areas in search of a better way of life.

POLICY IMPLICATIONS

Migration

1. Out-migration may occur in areas adjacent to those directly influenced by a development scheme such as irrigation. In-migration into the irrigated area may be minimal due to increases in land values.

2. Though there is an increasing amount of out-migration in the non-irrigated areas, migrants maintain contact with their villages and can be seen as agents of change. They bring different attitudes, values and ideas into the village as well as financial support. Planners should thus consider the migrant as a target population in their modernization schemes.[23]

3. If the intention is to decrease out-migration from rural areas, there should be some emphasis on diversification of occupations into nonagricultural activities, where land is not a determining factor.

Mortality

1. Differentials in mortality between the two types of areas were attributed to several factors that we cannot isolate at this stage, but rural development provides people with higher income and the ability to seek better health services. Proximity of a health centre may be an important factor, but wide dispersion of health centres alone may not cause wider use or better health.

2. Introduction of health services must relate to and co-ordinate with other development programmes to be successful. For instance, health services in the area should have had some concern with diseases related to irrigation and accidents related to mechanization as well as other traditional illnesses. In this way, the health system can be prepared for development-related changes.

Fertility

1. From our findings, it seems that irrigation helped lead to lower fertility through increased agricultural production, which resulted in increased incomes and mechanization, which led to less labour needed and, therefore, less demand for child labour. Thus, the economic benefits of children declined, resulting in a lower demand for children. These new attitudes, together with access to family planning information and techniques, contributed to a lower birth rate. Since this phenomenon was not observed in the nonirrigated areas, we see that the existence of a family planning programme in itself does not necessarily lead to a decline in fertility.

2. Higher levels of mortality and morbidity in the nonirrigated areas were a major obstacle towards the development of norms regarding a smaller family size. There, any attempt to reduce the fertility should be implemented in conjunction with an attempt to decrease mortality and morbidity. In the irrigated areas, apparently improved health and nutrition affected the number of births required to meet desired family size.

The population policy set forth in the Fifth National Economic and Social Development Plan set many goals, two pertaining specifically to this project: (1) reduce the population growth rate, especially in the Northeast, and (2) reduce migration to Bangkok. Rural development can more effectively reduce the fertility rate if it emphasizes more equal distribution of benefits. This would entail a more widely dispersed development programme, stressing wider improvements in conditions that influence fertility reduction, such as sanitation and health, income, education, and the overall standard of living. In this study, we have seen how development projects, though beneficial for the population they are to serve directly, may cause hardship to others nearby. It is important for planners to recognize such possibilities in order to minimize the unintended negative consequences of rural development projects.

Rural development is desperately needed in many parts of the world and is a major goal in many nations. Therefore, we believe the importance of studying the population impact of rural development cannot be overemphasized. We hope this study will assist in shedding light on the interrelationships between population and development and their importance to policy-makers and planners.

NOTES

Chapter Four

1. This research project was financed by the United Nations Fund for Population Activities (UNFPA) through a grant to the University of North Carolina at Chapel Hill. We would like to thank the UNFPA and the University for their support. We would also like to thank the tireless efforts of our five anthropological researchers who spent an extended part of their time living in each village. Finally, we would like to thank the villagers of Khun Lakorn, Nong Yai Ray, Ban Kok, Nok Ok, and Suan Hohm for their cooperation and patience in answering our questions.
2. National Economic and Social Development Board, Thailand, *The Third National Economic and Social Development Plan 1972-1976* (Bangkok: Office of the Prime Minister, Government Printing Office, 1971).
3. National Economic and Social Development Board, Thailand, *The Fourth National Economic and Social Development Plan 1977-1981* (Bangkok: Office of the Prime Minister, Government Printing Office, 1977).
4. The Lam Pra Plerng reservoir has a catchment area of 807 square kilometres and is 21 kilometres long. Water supplies are discharged into the 72 kilometers long main canal and distributed to various agricultural zones by laterals and tertianes. The Lam Pra Plerng irrigation project covers an area of 136 square kilometres, composed of four administrative districts (amphoes), namely Amphoe Muang, Amphoe Choke-Chai, Amphoe Pak Thongchai, and Amphoe Chakaraj.
5. ECI International, S.A. *Feasibility Report,* pp. 1-4.
6. Office of Lam Pra Plerng Irrigation Project, RID. *Report on Population.* March, 1972.
7. Kocher, James E., *Rural Development, Income Distribution and Fertility Decline* (New York: The Population Council, 1973).
8. Advantages and disadvantages of the anthropoligical methodology are discussed in detail in: Kaplan, David and Robert A. Manners, *Culture Theory* (New Jersey: Prentice-Hall, Inc., 1972).
9. Ban literally means village. Ban Suan Hohm thus means village of Suan Hohm. Tambol means of group of villages that together form a district. Amphoe is a group of districts.
10. Since the ratio of the latter to the former measures the dependency burden, the irrigated villages have a lower dependency burden, implying it is easier for them to support their children. ED.
11. By this procedure, we found some errors in measurement across the data, but they are minimal. We believe we can use this data set to measure population variables with a high degree of confidence.
12. Willis, Kenneth G., *Problems in Migration Analysis* (England: Saxon House; Washington, D.C.: Health Ltd. 1974).
13. The "carrying capacity of the land" is probably what is meant here. ED.
14. Kocher (1973) uses the term "underutilization of labour" and defines it as low levels of productivity, income and consumption.
15. Davis states that strictly agrarian systems have very little capacity for absorbing population increase. He cites one of the responses to growing population as being heavy outmigration. Davis, Kingsley, "The Theory of Change and Response in Modern Demographic History." *Population Index,* v. 39, n. 4, 1963.
16. Deaths are almost always underreported by households in direct questioning. ED.
17. Twenty baht equalled one U.S. dollar at the time of the survey in 1979.
18. This machine is basically a four-stroke Japanese engine. It is used as an irrigation pump in the paddy fields, to generate electricity for a household, when bolted on to a homemade truck as its engine, as well as in other uses.
19. Breese, Gerald., *Urbanization in Newly Developing Countries* (Englewood Cliffs, New Jersey: Prentice-Hall, 1966).
20. Wu, Tsong-shien, *Taiwan, Vol. 5, The Value of Children: A Cross-National Study* (Honolulu, Hawaii: East-West Population Institute, 1977).
21. And thus measure differences in the rates of change in the two types of areas. See Chapter 7, below. ED.
22. Because of the observed increased mechanization, presumedly. ED.
23. That is, as a catalyst for change.

Additional References

Chanlekha, Kamol., *Sarapi: Report on Socio-Economic Survey in a Northeastern Rural Community in Thailand* (Bangkok, 1968).

Gill, Richard T., *Economic Development: Past and Present* (Englewood Cliffs, New Jersey: Prentice-Hall, 1967).

Hazlewood, Arthur., *Planning Development* (London: Addison-Wesley Publishing Co., 1970).

Jakobson, Leo and Ved Prakash., *Urbanization and National Development* (Beverly Hills, CA: Sage Publications, 1971).

Kaufman, Howard Keva, *Bangkhuad: A Community Study in Thailand* (Tokyo: Charles E. Tuttle, Co., 1977).

Ministry of Public Health, Thailand, *Primary Health Care in Thailand* (Bangkok, 1978).

National Economic and Social Development Board, Thailand, *The Fifth National Economic and Social Development Plan 1982-1986* (Bangkok: Office of the Prime Minister, Government Printing Office, 1981).

Potter, Jack M., *Thai Peasant Social Structure,* (Chicago: University of Chicago Press, 1976).

Riley, James N. and Santhat Sermsri, *The Variegated Thai Medical System as a Context for Birth Control Services* (Bangkok: Institute for Population and Social Research, 1974).

Silcock, T.H., *The Economic Development of Thai Agriculture* (Canberra, Australia: Australian National University Press, 1970).

THE DEMOGRAPHIC IMPACTS OF THE CROSS RIVER PLANTATION PROJECTS IN NIGERIA

Joseph Uyanga[1]

To boost agricultural production and increase export earnings in the early 1950s, the Eastern Nigerian Development Corporation was commissioned by the Eastern Region Government to establish several large cocoa, palm, and rubber plantations in the Cross River Basin. The objectives of the plantation projects were:

1. To expand agricultural production by introducing modern scientific methods that would increase yields per acre and per tree;
2. To encourage population movement from the congested areas of the region to underpopulated areas; and
3. To foster rural economic growth in the region by generating paid rural employment and higher rural incomes.

The evaluation of the plantation projects has been agronomic and economic thus far; the demographic consequences have been left undetermined. The study reported here is concerned with determining the impact of the plantations on selected demographic variables, especially fertility.

This chapter presents a history of the plantation projects and their goals, the conceptual framework around which the research was designed, research methods and findings, and some brief policy implications as well as suggestions for future research.

THE DEVELOPMENT OF PLANTATION AGRICULTURE IN NIGERIA

Earlier History

Though the early British Colonial adminstrators in Nigeria sought to expand the production of export crops to increase government revenue, this was achieved not through the plantation system but by introducing improved seed varieties to local farmers and persuading them to adopt better cultivation methods. In fact, colonial administrators actively discouraged plantation agriculture on economic, social and political grounds, arguing that commercial plantations imposed heavy, fixed overhead costs of management. The peasant could adjust more easily to price fluctuations, it was believed, and would remain on his land when "broken planters would flee to their homes in Europe leaving their plantations derelict."[2] Under these circumstances, to establish plantations (which needed a lot of capital investment) while there was an efficient and cheap method that sustained trade at good profits was economically un-

wise for the colonial government. The plantation system also was condemned on social grounds. The most suitable areas for oil palm plantations were in Eastern Nigeria, but many of these areas were heavily populated. It was thought that the establishment of plantations in such areas would involve displacing many people from their land, thus disrupting tribal life.

According to the principles of the Dual Mandate, which formed the basis of British political policy in Nigeria, colonial administrators were morally obliged to protect the natives, their social life, and land from exploitation by foreign capitalists. However, the real reason that the British discouraged the establishment of plantations in Eastern Nigeria can be found in the increase of trade in plantation crops (especially oil palm products) that came about after the abolition of the slave trade and the establishment of "legitimate" trade in the area. The once neglected wild oil palm became treasured by local people who sold them to middlemen traders for sale at the ports to European merchants. Consequently, peasant tree crop agriculture became commercialized so that by the dawn of the 20th century the peasant farmers had established themselves as the sole exporters of oil palm products and later as growers of cocoa in Western Nigeria.

Because of the success of plantations elsewhere in the tropics, and the relative superiority of plantation production of products such as rubber in Zaire and palm oil in Malaysia, some foreign companies applied for and were granted land leases to establish and manage some plantations—the Pamol Nigeria Company in Sapele and the Calabar rubber plantations. Before 1950, however, only six plantations existed in the whole country, all located in the low population density provinces of Calabar and Warri. The total area under plantation was 12,644 hectares, with 40.7 per cent under rubber cultivation and the rest under oil palm. These early plantations were geared toward boosting export earnings and were of necessity profit-oriented. Wages were kept as low as possible. These plantations therefore had minimal rural development expectations.

The subsequent "plantation decade" of 1952-62 saw the rapid establishment of plantations in the sparsely inhabited districts enclosed by the Cross River (Table 1). Most were established through a corporation financed by the government of what was then the Eastern Region. The Marketing Boards also reinvested some of their profits from earlier sales of produce, particularly oil palm products, which helped in the establishment of palm oil plantations. The aims of the plantation projects were to increase production and export earnings, to spread benefit and prosperity to the producers, to diversify the economy of Eastern Nigeria, and to redistribute population from more densely settled to less densely populated areas.

It appears that the dominant criterion used in locating plantations was population density, since low density enabled easier acquisition of land, which was a tedious process of negotiation with the chiefs of the different ethnic communities concerned. Most plantations were owned by the state government but a few were owned by private companies, either in partnership with the government or via renewable leases.

Ecological factors such as rainfall, temperature, and soils, were also important determinants of plantation location. For instance, lands of the Ikom

Table 1

DISTRIBUTION OF PLANTATIONS IN THE CROSS RIVER BASIN

Plantation	Division Where Situated	Name of Plantation	Year Started	Owner
Oil Palm	Akamkpa	*Calaro Oil Palm Plantation	1954	State Govt.
	Akamkpa	*Kwa Falls Oil Palm Estate	1955	" "
	Akamkpa	Biase Oil Palm Estate	1962	" "
	Eket	Eket (Etebi and Esit Urua) Oil Palm Estate	1962	" "
	Ikom	Nsadop Oil Palm Estate	1953	" "
	Itu	Obtome Oil Palm Estate	1961	" "
	Ogoja	Boki Oil Palm Estate	1962	" "
Cocoa	Ikom	*Ikom Agbokum Cocoa Estate	1954	" "
	Ikom	Boje Cocoa Estate	1962	" "
	Ikom	Abia/Bendeghe-Ayuk Cocoa Estate	1962	" "
	Ikom	Cross River Forest & Cocoa Project	1965	" "
	Itu	Obtome Cocoa Estate	1961	" "
	Ikom	*Oboninta Cocoa Estate	1976	" "
Rubber	Akamkpa	The Cross River Rubber Estate Limited	1956	Joint—State Govt. & Commonwealth Dev. Corporation (CDC)
	Akamkpa	Oban (Nig.) Rubber Estate Limited	1952	Private
	Itu/ Odukpani	*Biakpan Rubber Estate	1963	State Govt.
	Obubra	*Eko Rubber Estate	1963	" "
	Odukpani	Pamol (Nig.) Rubber Estate Limited	1908	Private (subsidiary of U.A.C.)
	Itu	Use Ikot Amama Rubber Estate	1975	State Govt.

* Plantations chosen as sample areas in this study (see Figure 1, below).

DEM-100
LIBRARY

region, that were particularly suitable for the growth of cocoa, have earned the area the name of the Cocoa Region of the Cross River State.

Conditions in the Region before Plantation Development

Information on the preplantation population was gathered to shed light on living conditions of the Cross River area indigenes before and at the time of plantation development. Archival sources, especially Nicol[3] and Partridge[4] give helpful, if impressionistic pictures of life in the region. Evidently, clustered isolated compounds were the dominant settlement pattern. In these were quartered a man with his various wives and children. Grown sons would occupy sections of the compound with their wives and children. The bulk of the scanty population of the plantation zone was engaged in peasant cultivation, fishing, and hunting. An average family consisted of eight to nine children, but the existing villages were small compared to those in other areas (Table 2). The figures indicate the preplantation population of villages in the plantation areas compared well with that of similar areas chosen as a control group.

Our research focused on gathering information on fertility and mortality. One of the earliest fertility studies of the plantation area was conducted by Nicol[5], who reported a crude birth rate (CBR) of 58 births per 1,000 population and a gross reproduction rate of 3.2. This implies a total fertility rate (TFR) of about 7.6. Later Coale[6] estimated the following CBRs and TFRs for the study area based on the reported age-sex structure from the 1952-53 population census:

	CBR	TFR
Calabar region	57	7.8
Ogoja region	50	6.5

The Federal Office of Statistics in Lagos reported early in the 1960s a CBR of 41 for the rural areas of the study area. That implied a TFR of about 5.4. Yet data derived from a KAP survey of the region by Ascadi et al. (n.d.) yielded a CBR of 50 births per 1000 and a TFR of 7.2, and Edkanem, et al.[7] put the average completed family size for the area at 6.3. Thus, though the figures are not fully consistent, nor of high reliability, it does appear that fertility in the area was undoubtedly quite high.

Miss K. E. Shearman, a missionary, conducted investigations of family life in the area and reported that marriage was early and that local men took pride in having large families. She also attempted to collect information on childbearing but observed that this was difficult because the indigenes did not keep records of time. Using weaning time to establish ages of children and birth spacing, she gathered crude data on births and infant deaths and established that the infant mortality rate was especially high among children not yet weaned—approximately 395 per 1,000 births. McKeown[8] also confirmed the high infant mortality rates; he felt child mortality to be so great that probably half died before age one. Talbot, writing of the natives of the Upper Cross River Area, stated:

Table 2

PRE- AND POSTPLANTATION POPULATIONS
IN SELECTED PLANTATION AND CONTROL VILLAGES

	1952	1963	1973 (estimated)
Plantation Villages			
Uyanga	900	1934	2274
Uwet	280	815	1566
Akampka	1000	1431	3792
Aningeje	600	2006	2880
Nonplantation (control) Villages			
Ubium	3164	5007	5334
Afaha	4759	6390	6592
Okoyong	1000	2886	3430
Oku	504	1919	2639
Ikpe	2071	4116	5006

> "They (the Ekoi) seem utterly indifferent to the existence of Smells, and to this cause the high death rate among the children is due. So high is it indeed as to be hardly more than covered by the birth rate. One day sixty-two married women were chosen haphazard in Oban Town. To these it was found that 270 children had been born, of whom 163 had died. This gives an average of 4.3 children to each, of whom only 1.7 now survive. Of these sixty-two women one had borne 15 children and seven others ten or over, while only four were childless.[9]

The region was described by Johnston[10] and Talbot as the most isolated and primitive of Southeastern Nigeria—"an utter wilderness virtually uninhabited by man."[11] While a few Ekoi fishing villages were located along major rivers, other settlements were mostly occupied by slaves who worked absentee masters' farmlands. Forde[12] shows that of the 75 or so square kilometres of area in this region which had ever been mapped, barely six square kilometres were actually cultivated. The 1952-53 census of parts of Akamkpa and Ikom reported the following: total males 12,111; total females 9,018; and population in age group 0-14, 9,560, (44 per cent).

These historical studies provide a general description of the sparse population of the area, the existence of a few large households and extended family compounds and an economy based on fishing, hunting, and peasant farming, where both fertility and infant mortality were very high.

CHARACTERISTICS OF THE PLANTATIONS

Location, Land Area, and Production

The 19 plantations in the Cross River region are found at various distances northeast of Calabar in the Cross River Basin (Figure 1). Two major highways, the Calabar-Ikom and the Calabar-Ikang/Cameroon, connect the plantation zone to other areas. None of the plantations is less than 30 kilometres from Calabar. There are no other towns except Ikom (pop. 2,823) within the plantation region.

The total acquired acreage of the 17 government-run plantations rose from 122,166 to 157,019 in 1976 and to more than 200,000 in 1979. During 1965-76, the area for oil palm and rubber plantations rose by 19 per cent and 26 per cent, respectively, and the area of mature trees by 45 per cent and 53 per cent, respectively. With a 24 per cent increase in area of mature trees, the cocoa plantations expanded the least. Besides improved quality of product, an argument for plantation agriculture was that a more scientific system would increase the yields per acre and per tree. Data are hard to come by in order to compare the yield and income of privately cultivated tree crops in this and other parts of the country with that of the plantations. In 1977 the smallest harvested hectarage (8,548) was for oil palm and the highest (12,145) for cocoa. The yields per hectare and per tree, however, were largest for oil palm and smallest for cocoa. Between 1952 and 1976 rubber contributed 71.9 per cent to the total value of plantation sales, oil palm 21.2 per cent, and cocoa 6.9 per cent.

Between 1969 and 1976, the volume of cocoa produced nearly tripled and the value increased tenfold. Palm oil production also grew as palm kernel sales declined. Rubber production was erratic, despite increased prices.

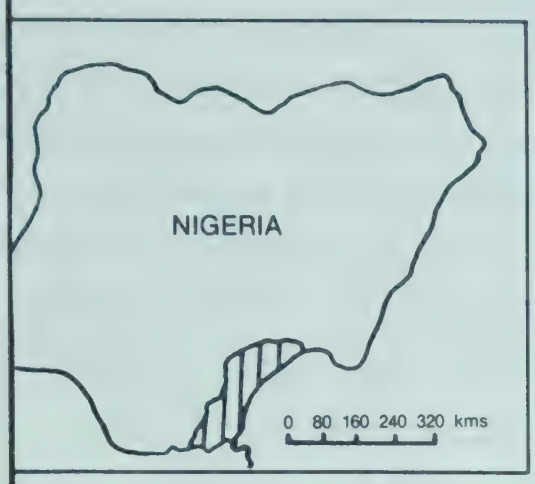
Employment on Plantations

Because of the failure of small-scale rural industrialization to check rural-urban migration, plantations were conceived as a means of diverting potential urban migrants to rural areas. Before the plantations were established in this region, it was virtually unoccupied. A high proportion was under forest and isolated from the rest of the country because of the absence of roads or a communication network.

Plantations have generated new small-scale business enterprises in the area. Around two of the plantations, Calaro and Kwa Falls, 413 small businesses were counted. These businesses, the most important of which are motorcycle and bicycle repairs, shoemaking, barbershops, bars, restaurants, tailoring, furniture shops, and small general stores, depend on the patronage of the plantation workers.

With increased rural employment in the area, the local people tended to move from subsistence farming, palm wine tapping, and unpaid family labour into single skilled jobs, or multiple part-time occupations. In general, therefore, one observes increased rural occupations and wages, and more secure and improved income status; this may imply other benefits including greater psychological well-being and increased ability to plan for the future.

THE DISTRIBUTION & SIZE OF PLANTATIONS



CROSS RIVER STATE
(Study Area)

Ik = IKorn Plantation
Ab = Abie "
Cr = Cross River "
Je = Boje " "
Bo = Boki Oil Palm "
Ns = Nsadop " "
Ca = Calaro " " "
K = Kwa Falls " "
Ib = Iblae " " "
Bl = Biakpan " " "
Ob = Oban Rubber "
Pa = Pamol "
Nk = Niko Rubber Plantn.Obubra
Ul = Use Ikot Amama Rubber
E = Eket (oil Palm)

KEY

Hectarage with mature tree
" " immature "
" under reserve
" " non-arable "

Plantation workers make up about 30 per cent of the total regular and paid employment in the state public sector. More than 75 per cent of those employed are unskilled. Two types of labourers exist: permanent workers who work full-time on the plantation and the casual or part-time labourers in jobs like harvesting, weeding, planting, etc., hired when needed. Both provide employment for the rural population, thereby possibly reducing rural-urban migration. More important, however, they reduce the degree of underemployment or seasonal unemployment in rural areas. The local people can split their time between everyday economic activities and working on the plantation for extra income. Casual labour also helps supplement labour requirements in times of acute shortages as was the case after the civil war (1972). Casual employment can vary greatly from year to year and the numbers of permanent employees is also unstable (Table 3).

Social Services and Structure

The amenities available on plantations include housing, medical facilities, pipe-borne water, electricity and roads. Absence of such amenities is often considered a major push factor in rural-urban migration. They could therefore be important for reducing the intensity of migrant flows to urban areas. Housing, for example, is provided for plantation workers at very low or no rents: most unskilled workers are allocated one- or two-bedroom houses, with toilet and kitchen. Those designated as "staff" have two to three-bedroom bungalows. Allocation of housing depends more on seniority than family size. Both electricity and water are free. Housing is not provided for the casual labourers, who live in nearby villages.

Medical facilities are provided free to all workers on plantations as well as their immediate families. The clinics provide free family planning services. Serious medical problems are referred to bigger hospitals at Calabar at the expense of the plantation management. The clinics are not exclusively for the plantation workers. Other community members also benefit from them, although they must pay for the services.

Plantations also have primary schools that serve both themselves and the local communities. Unlike medical facilities, schools are free to all, and teachers are supplied directly by the state government. Secondary schools are near some of the plantations. However, because of the quality of facilities and staffing, many plantation parents prefer to send their children to boarding secondary schools in Calabar and in other towns.

Many plantations also have recreational facilities and equipment for football, table tennis, lawn tennis, and indoor games. Some of these are also open for public participation. Some plantations even have television sets, guest houses, clubs, and hotels.

Settlement patterns within the plantations are the "industrial enterprise compound type" and do not follow traditional rural characteristics. An interesting pattern within plantation compounds is the clustering of migrants by ethnic origins to form "wards." In one of the sample plantations, there was

Table 3

LABOUR BY OCCUPATIONAL CATEGORY AND BY TYPE OF PLANTATION, CROSS RIVER STATE 1970-1977

Year	Per-manent	Casual	Permanent: Admin. and Managerial	Permanent: Clerical and Skilled	Permanent: Un-skilled	Permanent: Total	Casual	Permanent: Admin. and Managerial	Permanent: Clerical and Skilled	Permanent: Un-skilled	Permanent: Total	Casual	Permanent: Admin. and Managerial	Permanent: Clerical and Skilled	Permanent: Un-skilled	Permanent: Total	Casual
	TOTAL			OIL PALM					RUBBER					COCOA			
1970	7793	948	34	461	1500	1995	635	28	777	3545	4350	313	8	213	1227	1448	0
1971	7172	420	10	315	2255	2580	41	54	855	3042	3951	0	5	192	444	641	379
1972	6446	5507	14	302	1308	1624	5146	45	873	3270	4188	0	4	196	434	634	361
1973	9381	1805	16	386	2521	2923	1067	61	1406	3517	4984	0	17	115	1342	1474	738
1974	10506	2131	20	374	3460	3854	1562	59	486	5038	5583	131	16	160	893	1069	438
1975	8695	2695	21	252	2202	2475	2199	59	430	4532	5021	53	27	127	1045	1199	443
1976	*9387	*4220	27	366	3650	4030	906	91	2058	1972	4121	2083	35	488	478	1001	1098
1977	*6192	*5324	31	350	2996	2977	1818	97	470	1357	1827	1947	15	129	1027	1171	1095

Source: Plantation Statistics — 1970-1977 Ministry of Economic Development, Calabar.

* Includes figures for coffee and citrus plantations.

a "Bette compound" for the Bette people of Obudu and a "Bakwarra compound" for the Bakwarras of Ogoja. This is probably the result of chain migration since information on job availability is transmitted by friends and relatives already working on the plantation.

Labour Recruitment and Plantation Organizations

Job positions and opportunities in the plantations are advertised at the headquarters of the Agricultural Development Corporation (ADC) at Calabar and also in local newspapers. Skilled persons seeking jobs and admission into the plantation projects normally have to respond to these advertisements and present themselves at the Agricultural Development Corporation headquarters at Calabar for selection by a panel of officials including the plantation manager, personnel manager, and other technical officials from headquarters. The plantation manager also recruits casual and unskilled workers from migrants and local residents who present themselves, particularly during the peak harvesting, clearing, pruning, or planting seasons.

All plantations follow the Nigerian Government fixed salary/wage and tenure structure. Workers are individually paid once per month. (There is no profit sharing or other incentives for individual workers.) In the government plantations, the produce is shipped to a central collecting/sales depot in Calabar where the ADC—the general manager of the plantations—takes charge of sales and export. Proceeds from sales are kept at the ADC headquarters; only money for repairs, recurrent expenditures, and salaries is sent to the plantation managers. While most plantations operate with a good margin of profit, a few plantations with poor management and aged machines and equipment must depend on government subventions.

Jobs are often guaranteed for the skilled and confirmed staff according to Government Civil Service regulations. Casual and unskilled workers are not protected even though they earn the government fixed minimum wage; their retention depends on the volume of work in the plantation and the season. As members of the Agricultural and Allied Workers Union, permanent plantation workers exert a powerful influence on the government to block terminations of employment and lay-offs. Jobs cannot be inherited, and confirmed plantation workers may retire on government pension as do other civil servants. Retired workers return to their villages or often settle in urban areas.

Skilled plantation workers are full-time employees. There are no local jobs off the plantation except those related to self-employment in petty trading, services and farming. Most wives are either employed along with their husbands on the plantations or are engaged in food production or petty trade. An average plantation household includes a husband, wife, and young children. Children assist in housework and are not employed on the plantations or on the family food production plots.

Plantation dwellers rarely have off-plantation jobs, being engaged ten hours a day (with a break for mid-day meal) from 7:00 a.m. to 5:00 p.m. five days per week. Most plantation households own small individual plots either within or outside the plantations where they grow yams, cassava, maize, plantains and vegetables for home consumption.

Local Nonplantation Employment

A large proportion of migrants, mainly from densely populated mainland areas, came to the plantation project region but are not working on the plantation projects. It is obvious that while most had hopes of working on the plantations, they also were motivated by other things, such as part-time food crop cultivation, trading, etc. Some are in the area waiting for plantation jobs; others have settled into new livelihoods. The cultivation of food crops and miscellaneous business and trading transactions occupy the migrants who are not engaged on plantation projects. The farmers cultivate, using mostly family labour, vast farmlands of cassava in areas hitherto left as high forests or previously farmed by domestic slaves belonging to the various houses of the Efik city-states at Calabar. The staple foods produced are sent to the Calabar urban market. Many owners of land do no farming and depend on rents from their tenants.

The nonplantation migrants visit their homes once or twice a year, and the money and wealth they bring back speak louder than words in terms of attracting new migrants—friends, relatives, and former neighbours. Migrants from the same origin areas tend to settle in the same locality for purposes of easier social adjustment in a new environment. The migrants have founded several new villages where none existed before in the Cross River area. An increasing number of self-employed, rich migrants now invest in permanent houses, which provide accommodation for new migrants and rent to supplement their owners' incomes. Some told us they intend to sell these houses to other migrants upon returning home; in fact, no migrant saw the plantation or the nonplantation settlements as a permanent abode. Almost all the migrants who responded intend to return to their home villages, even though many have spent more than 12 years in the Cross River Region.

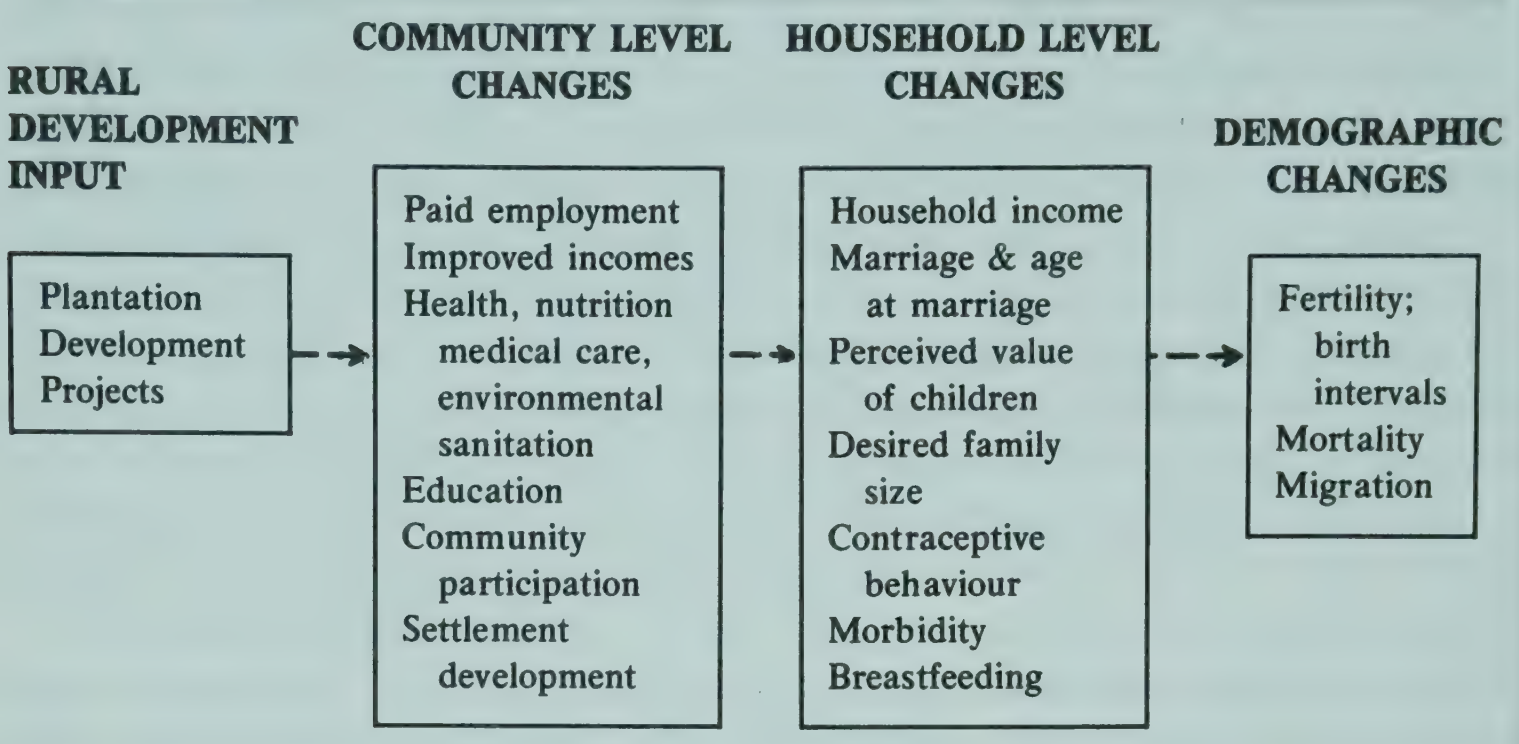
THE THEORETICAL MODEL AND HYPOTHESES

A sketch of the theoretical framework for this study shows the interdependence of fertility behaviour and decisions with several other household decisions and indicates that rural development activities rarely have impact directly on demographic variables (except migration). Instead their impacts are transmitted by affecting one or more of the determinants, say, of fertility decisions. Thus, any type of rural development project will first affect one or more factors that influence fertility—family income, education and health, relative prices, household tastes and preferences, or community characteristics. These, in turn, affect the role of women, motivation for childbearing, and perceived cost and value of children, and may induce changes in three categories of household decisions: fertility and fertility control; money allocations for goods and services for children (including education and health care); and time allocation.

There are various patterns of relationships and processes through which a rural development project can affect fertility (Figure 2). Plantation development is considered as a modernizing process that can result in socioeconomic changes, which in turn may generate demographic responses at the community and household levels through the alteration of felt needs, expectations and

Figure 2

EFFECTS OF RURAL DEVELOPMENT ON FERTILITY



reproductive behaviour. From Figure 2, it is obvious that the demographic impacts tend to be indirect.

Initial goals of this project were to analyze the development of the plantation projects since their inception and assess the pattern of migration into the project areas. The study also was designed to shed light on the relationships in the figure by testing specific hypotheses concerning the effect of community and household-level variables on demographic behaviour.

At the end of the study, we hoped to be able to answer the following questions:

1. What are employment and income levels as the result of the plantation projects?
2. What have been the levels and patterns of migration into and out of the plantation areas? What effects have these had on population distribution in the area and the region?
3. What have been the decisions affecting marriage, childbearing, and child spacing in the project area? How are these different from such decisions in the control groups?
4. What specific characteristics of plantation employment may have contributed to any differences in the plantation and control groups?

As can be seen from the questions, the underlying hypothesis was that the modernizing and income-generating effects of plantation projects have affected fertility, migration rates, decisions affecting nuptiality, family size, and the total economic welfare of the participants.

A number of specific relationships suggested in the literature are presented below and are particularly focused upon in the empirical research. The effect of such development-related factors on *fertility* is emphasized.

1. *Effects via changes in the economic value of children*

It is held that the economic value of children declines as economic development proceeds. To the extent that the economic contribution of children has ceased to be a major motivating factor for large families, any rural development project that established a quasi-urban economy and norms will affect the economic value of children and the desire for many children, either by reducing child labour needs or by increasing the time and financial costs of children. Because plantations provide secure employment for residents and generally use only adult labour, the value of children in agricultural production is expected to decline for migrants to the plantations.

2. *Effects via changes in income*

The relationship between rural income and fertility has not yet been conclusively shown. Simon[14] presents a threshold relationship of fertility to income in which fertility first increases, then decreases as income rises. Becker and Lewis[15] propose that an increase in income would lower the demand for children to the extent that parents with higher incomes have an incentive to substitute quality for quantity of children. On the other hand, higher earnings mean better nutrition, better access to housing, social services, and medical care, all of which can lead to higher fertility where there are no incentives for family planning or access to contraceptives.

3. *Effects via changes in education*

There are a number of speculative linkages in the literature between education and fertility. There is general support that education is associated with a number of factors that would reduce fertility, including: delay of marriage for women; lower infant and child mortality; smaller ideal family size; lower desire for sons; lower perceived benefits and higher perceived costs of children; and better knowledge, more effective use, and higher acceptance of contraception. Education, however, also has been tied to higher fertility and shorter birth intervals because it leads to better health (and increased fertility) of couples and because educated women are less likely to follow traditional cultural patterns such as long periods of lactation and postpartum abstinence.

As only children attend school on plantations, their parent's formal education is not improved by moving to plantations. However, there may be some carry-over of literacy skills to parents. Since the plantations have now been functioning for nearly 30 years, there has been time for a number of cohorts of children to be educated. Whether or not these children get jobs and remain on the plantations is unclear, however, and a topic to be investigated in this research.

4. *Effects via changes in women's roles*

A popular proposition is that rural development projects have negative effects on women's roles, particularly (1) where women's participation in the subsistence economy is high and (2) where there is an excess of landless hired female agricultural labour. However, it is held here that some rural development projects increase women's participation and their productivity, and reduce the

tediousness and amount of time spent in agricultural work. The relation of fertility to women's roles depends on the type of female labour participation. Available evidence suggests that female participation in subsistence agriculture or house-based employment is either positively related to or has no significant impact on marital fertility. The reasons lie in the apparent compatibility between this type of work and marital fertility where, for example, a woman may keep her children with her while working. Thus she does not have to choose between two roles. Moreover, the value of children as productive helpers is relatively high and the cost of childbearing low, motivating women to have many children and not to practice birth control.

The displacement of women through agricultural modernization, in the absence of alternative employment opportunities, also can have negative consequences for their status and roles in the family. This may give rise to pronatalist consequences because women's reproductive roles may become the only significant roles open to them.

With regard to employment in off-farm industry, the literature generally suggests a positive or lack of relationship between off-farm employment and marital fertility in the rural areas if cheap domestic help is available, if an extended family residence pattern ensures the presence of surrogate mothers, or if flexible working periods provide compatibility between child care and work patterns.

All of these tentative relationships between development-related variables and fertility lead to specific questions regarding the particular impact of plantation-type employment and residence on the fertility of those who have migrated to plantations, as well as those who live near them and thus reap benefits from the plantation's social services and its broader economic effects.

The ideal investigation of all the relationships above (hypotheses 1-4) includes a comparison of pre- and postplantation attitudes and behaviour of workers but this information is not available. A major shortcoming of this project is the inability to generate a good "before-and-after" data base for the plantation population. Historical sources that contain some anecdotal information on the region before plantation establishment (including the life styles and conditions of the indigenous population) allow for some tentative comparisons of human conditions in the area pre- and postplantation, but these are both sketchy and possibly biased. Because of this, another method of establishing some comparisons was necessary. The next section explains the reasoning behind and the process of selecting the control group.

DATA COLLECTION PROCEDURES

Selection of Areas

The data on the current economy and population of the basin were collected in a survey using a modified version of the World Bank multi-purpose questionnaire.[16] An analysis based on a "before-after" study of areas was not possible because of the impossibility of relating preplantation data to project

participants. An alternative was the choice of a suitable nonplantation region (an area outside the plantation region, which was not actually a major source of outmigration to the plantations) and the assessment of the same demographic processes among the resident population there. We decided to compare relevant variables for the plantation and nonplantation sample groups (controlling for basic socioeconomic characteristics), rather than for the plantation population at two different times. It was necessary, of course, that the locational and geographical factors in the two regions not be significantly different, implying prior equivalence, within population strata, of the plantation and nonplantation respondents in respects other than the exposure of the former to the project.

The selection of the control area was undertaken with care, based on statistical data and the research staff's knowledge of the economic and social characteristics of the region. The selected nonplantation areas—Ikot Expene, Abak, Etinan, and Uyo rural areas in the mainland part of the Cross River area—are situated between 164 and 286 kilometres from the plantations. Their economies are cash-and-food-crop-oriented and they are very similar, both culturally and socioeconomically, to the plantation areas. This allows a useful analysis and comparison of the demographic and socioeconomic situations (at interview period) of the plantation and nonplantation (control group) populations.

Field Procedures and Pretest

The procedures used to gather data in 1979 are discussed here in detail in hopes that they may be useful to others. Two research assistants, two field supervisors' assistants and 20 interviewers were hired to execute the project. The preliminary work involved a visit by the principal investigator to the plantation region and the nonplantation control area to meet chiefs, project managers, and community leaders in these areas. It also involved formal training of the interviewers, supervisors, and assistants in translation and pretesting of the research instruments and the acquisition of maps and charts of the study areas.

The pretest of the questionnaire proved very important as we learned that some words used in the instrument were inappropriate, misunderstood, or even repugnant to the respondents, particularly those related to fertility and contraception. There were two basic problems.

First, most family planning devices are quite new and unfamiliar to many people in the study area. Even some of the interviewers came to know about these methods only when they were specifically trained for the survey. In the pretest of the questionnaire translated from English to the local language (Efik), there was a high rate of nonresponse to questions about modern family planning methods. On examining the factors that might be associated with the low response, it was found that the local names for the family planning devices were not familiar to nonacceptors and it was difficult even for users to associate the names with the devices, especially for illiterate respondents. With the exception of the pill and Depoprovera, other contraceptives had to be circumspectly and elaborately described to convey the proper meaning; there are no local names

for IUD, foam, condom, etc., because these are new to rural residents. To overcome this problem, the schedule required that the interviewer describe as simply as possible each of the methods. The description associated the methods with how they are used to aid the respondent's recognition. For instance, it was said that the IUD was inserted (in the uterus); the condom was worn by men (on the penis); foam was deposited (in the vagina) before sexual intercourse, and the one-a-day pill was swallowed. We discovered, however, that the interviewers sometimes felt shy explaining the devices to respondents. This could partly be accounted for by the fact that in this culture people do not find it easy to discuss sexual matters or female genitals. Thus, it was difficult for interviewers to ask the questions about contraceptives directly without creating a bad impression upon the respondents, who also were often their elders.

The second problem also relates to cultural norms but is more directly a linguistic problem. Even after translating the contraceptive terms we found that the words used in everyday men's language for reproductive terms such as vagina, penis, womb, intercourse, etc., were quite different than the "modest" names women used. So we had to obtain this new vocabulary and translate the ideas again, using more polite terminology. A sample comparison of the two languages is shown below.

Terms in English	Terms in everyday Efik language (referred to as dirty words)	Terms considered modest (polite) by our resource personnel
Vagina	Itit	Idem Iban (woman's body)
Penis	Mfet, Ekporo	Idem Iren Owo (man's body)
Womb	Esit idibi Efok eyen	Idibi (belly, stomach) Itie nna eyen (the place where the child lies). Also used to refer to the uterus.
Sperm	Nsene	Iyip (blood)
Intercourse	Inah,	Ana ye eyen anwan (keeps with lady)

A different problem presented itself with the section of the questionnaire dealing with the pregnancy history. We wanted to measure the incidence of stillbirth, abortion, and child mortality. The literal translations prepared for the pretest were also not successful. The table below shows the translation before the pretest and the modification after it.

Appropriate translation of terms in survey research is crucial because one wants to use the language most easily understood and responded to in order to get reliable data. It was clear that our "modest" words evoked better responses

than the "dirty" words; during the pretest, only 12 of 80 respondents (15 per cent) responded affirmatively to at least one of the questions on the three concepts, while 165 out of 200 respondents (83 per cent) responded affirmatively to the same questions as modified during the main survey.

Translation before pretest: everyday colloquial language		**Modification suggested after pretest to minimize emotion**	
English	**Efik (dirty or impolite**	**Efik (modest)**	**English (literal meaning)**
Stillbirth	Obukpo eyen	Eyen otuk fi	A child that cheats you
Abortion (purposeful) or Miscarriage (accidental)	Osiono idibi	Idibi	Pregnancy terminates before full term
Dead child/ children	Mkpanga ndito/ eyen	Eyen/ndito fo emi miduhe ke	Child/children not living

We also experienced a problem in our pretest questionnaire when the question on contraceptive methods was translated from English to Efik. The first translation we used implied a complete break or total prevention of childbirth, such as might be caused by sterilization, a method not practiced in Nigeria. Further probing led us to understand, however, that there were local words which, when loosely translated, implied protection or prevention (nkpeme idem). Using this concept, women would be able to associate such traditional practices as abstinence, the use of native herbs, enemas, and other traditional medicines with "family planning." These traditional methods had long been known and had been widely used to prevent unwanted pregnancies or to space pregnancies. The result was that on the pretest, a respondent might indicate that she had not heard of any "contraceptive method," thinking all the time that the reference was to devices that completely stopped childbearing.

A final problem associated with the translation of the concept of contraception was the interpretation of "to avoid having children." In Efik culture all *children* are said to be loved and wanted, especially by women. What may not be wanted or desired, however, is a particular *pregnancy.* Therefore, the translation may sound very strange to respondents who had never thought about contraception to prevent "unwanted children" but rather to prevent "unwanted pregnancies." This distortion was corrected by replacing the idea of total prevention with a more accurate concept, of protection against unwanted pregnancy or for child spacing (mkpo ndino fi ifet mbemiso afiak enyene idibi. . . , i.e., to give some time after giving birth).[17]

Sample Selection

Because the plantations differ in size, type of operation, and ownership, it was decided that: (1) samples would be drawn from only the 17 major government plantations,[18] and that (2) the largest and smallest plantation and (3) at least one plantation of each (crop) type would be included in the sample. After the largest (Calaro Oil Palm) and smallest (Ikom Cocoa Estate) plantations were chosen, two plantations each were randomly selected from the remaining six oil palm plantations, five cocoa plantations, and six rubber plantations. In all, eight plantations were included in the sample. All plantations selected are located within the Obubra, Ikom, Akamkpa and Itu/Odukpani local government areas (see Table 1 and Figure 1 above).

Within each plantation, the sampling frame consisted of all married plantation workers currently listed on the payroll. Payroll sizes ranged from 200 to 1,100 names, but most were from 700 to 1,000. Workers were randomly selected from this list, provided that no wife whose husband had been selected should form a separate independent selection. From a total of 221 workers, a sample of 100 was selected from Ikom Cocoa estate and 600 were selected from 1,104 workers from Calaro Oil Palm Estate. In all other cases, the sampling was 25 to 35 per cent of the workers.

In the control (nonplantation) area, the procedure was different. After the region was selected (namely, an area comprising Uyo, Ikot Ekpene, Abak, and Etinan local government areas), the clans (groups of 20 to 60 villages) in these local government areas were listed. From a total of 33 clans, 10 were randomly selected. All 922 villages in the 10 clans were listed. From this list 200 villages were randomly selected.

Villages in the control area consist of closely located sets of extended family compounds most often comprising the head of the compound, his wife or wives, his children, his unmarried sisters and brothers, and sometimes his aged parents. They ranged from 500 to 1,200 in population (or 100 to 400 households). An interview unit consisted of one or two married heads of households within a compound. A household in this case was regarded as a man, his wife, and the children born by his wife or wives. Every 15th compound along the village road was visited for interview. The first head of household met was interviewed with a second also interviewed depending on the size of the compound.

On the plantations, residences of workers selected for the sample from the payroll list were identified from a list kept by the estate engineer at the various plantation locations. Visits were made to these quarters and the heads of the households interviewed. In both plantation and nonplantation areas, husbands and wives were always interviewed together provided that where a marriage was polygamous only one wife (chosen by the husband) was considered eligible for interview. The oldest wife was always selected.

Interviews were carried out mostly in the evenings and on weekends. Complete interview schedules were returned for 2,116 respondents from the plantations and 1,920 respondents from the nonplantation areas. Interviews were supervised by the field assistants who reported any problems encountered to the principal investigator at Calabar. Before questionnaires were sent to the central office they underwent field editing. Editing questionnaires immediately after they

were turned in by the interviewers to the supervisor served a number of purposes including discovery of any need for additional information while in the field, thus avoiding the need for costly transportation later.

Very few nonresponses were recorded. Where calls were made and individuals were not at home, call cards were left to show when the interviewer would call again. After two unsuccessful calls the interviewers were always advised to substitute the household with the next one.[19]

Respondent co-operation was quite good because of the helpful role played by community leaders, chiefs, and plantation managers. A plantation manager and a chief (a well known high school headmaster) were field supervisors. Several plantation workers (foremen and supervisors) served as interviewers. Most of the interviewers were indigenes of the areas they surveyed.

While the bulk of the work involving coding was done by research assistants at Calabar, the lack of computer facilities required that the punching and tabulation be done at the University of Lagos Computer Center.

DATA ANALYSIS AND RESULTS

Characteristics of the Sample Populations

We collected data on age, marital and occupational status, ethnicity, income and education of the household head and (selected) wife (Table 4). The majority of heads are in the 21-30 year age group, followed by the 31-40 year age group.

Because the sampling frame consisted of currently married heads of households, the only marital characteristic assessed here is type of marriage. Polygamy has a lower prevalence than monogamy among both sets of sample subjects, though a higher proportion of the nonplantation households are polygamous (20 per cent versus 5 per cent). Similar levels have been observed by Lucas.[20] We noted that the extent of polygamy varied directly with the age of the household head, being almost nonexistent among the 21-30 year age group.

The majority of the heads of households in the two samples have attained the primary six level of education, and slightly more than one-fifth in the nonplantation and about one-third in the plantation population had some secondary school. As should be expected, a larger proportion of the nonplantation workers had no formal education. The pattern is almost the same with regard to wife's education, though a larger proportion had at least some formal education.

Occupations on the plantation can be divided into white-collar, skilled, and unskilled labour. The distribution of labour categories is roughly similar among the nonplantation sample, through there are, of course, many more who classify themselves as farmers. The level of female participation in paid employment is surprisingly high in both samples, but as expected, more employed females were found in the plantation population.

In both the control and plantation areas, median income is in the range £2000 to £3000 within which about one-third of the households can be classified. But whereas only about one-fifth of the nonplantation population earn over

Table 4

SELECTED SOCIOECONOMIC CHARACTERISTICS OF HOUSEHOLD HEADS

	Plantation Population		Nonplantation Population	
Characteristics	**Number**	**%**	**Number**	**%**
Marriage				
Monogamous	1999	94.5	1554	81.2
Polygamous	117	5.5	366	19.8
Education				
None	132	6.1	322	16.8
Primary	1204	57.2	1061	55.3
Secondary	615	29.1	425	22.0
Higher	148	7.0	84	4.4
Other	21	1.0	28	1.5
Wife's work status				
In labour force	1002	47.4	583	30.4
Not in paid labour	1114	52.6	1337	69.6
Husband's occupation				
Farming/trading/ fishing	8	0.4	760	39.6
Skilled labour	651	30.7	377	19.7
Unskilled labour	1145	54.1	645	33.6
White collar	214	10.3	113	5.8
No job at moment	98	4.6	26	1.3
Household annual income*				
205	9.6	401	20.9	£1,000
£1,000-£1,999	617	29.2	538	28.0
£2,000-£2,999	939	34.9	616	32.1
> £3,000	505	26.3	365	19.0
Age distribution				
0-20	111	5.2	76	3.9
21-30	1034	48.9	—	48.6
31-40	838	39.6	745	38.8
41-50	102	4.8	132	6.8
50+	31	1.5	38	1.9
Ethnicity				
Efik	132	6.3	19	0.98
Ibibio/Annang	1312	62.0	1872	97.52
Ekoi group	636	30.0	11	0.57
Other Nigerians	36	1.7	18	0.93
Wife's education				
None	41	1.9	755	39.3
Primary	1590	75.1	908	47.3
Secondary	313	14.8	150	7.8
Higher	72	3.4	32	1.7
Other	100	4.8	75	3.9
Total	2116	100.0	1920	100.0

*Nigerian pounds

£3,000, more than one-quarter of the plantation population can be so classified.

The sample groups are made up of the Ibibios, Efiks, Ekoi, and related linguistic groups.

Project Effects on Migration

One of the main reasons for establishing plantations was to redistribute population within the state. The former eastern Nigerian government noted that "one of the problems confronting rural development today was the concentration of people in a few rural areas that are in short supply of farmland while others are virtually uninhabited.[21] One aim of the plantation projects was to encourage migration from the densely populated southwestern part of the state.

A total of 88 per cent of the respondents in the plantation project areas were migrants. Of these, the majority (56.4 per cent) arrived at the project areas during the "plantation decade" (1950-60), 26 per cent during the period 1961-70, and only 17 per cent during the 1970s. One explanation for this trend may be the growth of alternative sources of rural and urban employment in the state during the latter periods.

The majority of migrants are males aged 21-30; many came to the plantations at ages 16-18 after their schooling and have been on the plantations for up to ten years. Migrants in the age group 21-40 make up three-quarters of all migrant household heads to the project areas (Table 5). To what extent has migration fostered population redistribution from the densely populated parts of the state? From Table 6, it can be seen that nearly 70 per cent of all migrants come from high density areas of the state.

Migrants have come to the plantations primarily because of their inability to make a living in their area of origin. When asked their reasons for migrating, 40 per cent stated they were unable to get a job at home. Sixteen per cent said their former work was not lucrative enough, while 15 per cent said there was not enough farmland in their home area. A tenth said they had come to cultivate food crops (but later got on the plantations) while about a fifth gave a combination of the above reasons. Only one percent said they came for family reasons or for a change in environment.

Project Effects on Family Size Preferences

1. *Ideal and preferred family size*

When asked about the additional number of children desired, many respondents gave a nonnumerical response or said that it was "up to God." It is not convincing that all these households want a very large number of children or that they did not understand the question. Probably this response was a way of avoiding direct confrontation with an issue believed to lie beyond the control of the respondent. Stating the desired number of additional children may be difficult for many, particularly considering the high incidence of miscarriages and infant mortality.

When considering the responses in the aggregate, there are no significant differences between the two samples in the number of additional children desired, regardless of the number of living children. Nevertheless, the nonplantation

Table 5

AGE-SEX COMPOSITION OF HOUSEHOLD HEADS WHO MIGRATED TO THE PLANTATIONS

	Male		Female		Total	
Age in Years	**No.**	**%**	**No.**	**%**	**No.**	**%**
<20	77	9.6	57	13.4	134	10.9
21 - 30	400	49.8	213	502	613	49.9
31 - 40	167	20.7	131	30.8	298	24.3
>40	160	19.9	24	5.6	184	14.9
TOTAL	804	100.0	425	100.0	1229	100.0

Table 6

ORIGIN OF WORKERS MIGRATING TO THE SAMPLE PLANTATIONS

Origin	**Number**	**Percentage**
High density areas (>500 persons per km.²)		
Uyo	81	
Etinan	54	
Abak	96	
Ukanafun	37	
Ikot Ekpene	83	
Itu	102	
Total	453	36.9
Moderate density areas (300-500 persons per km.²)		
Ikono	161	
Ikot Abasi	134	
Eket	62	
Oron	52	
Total	399	32.5
Low density aress (<300 persons per km.²)	212	17.2
Outside the Cross River State	165	13.4

Table 7

PERCENTAGE DISTRIBUTION OF ADDITIONAL CHILDREN WANTED BY NUMBER OF LIVING CHILDREN—PLANTATION AND NONPLANTATION POPULATION

No. of Living Children	Additional Children Wanted							Sample Size
	0	1-2	3	4	5	6+	Up to God*	
PLANTATION POPULATION								
0-2	0.0	4.2	4.7	12.0	19.0	21.2	38.7	784
3-4	0.5	4.1	8.4	10.2	16.2	23.1	38.1	645
5-6	1.7	0.9	16.8	25.2	15.4	16.2	26.0	539
>6	22.3	23.7	13.9	14.4	10.7	9.7	8.3	148
All Households	9.4	10.6	9.6	12.4	14.0	17.5	26.5	2116
NON-PLANTATION POPULATION								
0-2	0.0	3.3	5.0	10.7	12.2	20.1	48.7	814
3-4	0.9	4.0	6.6	10.0	19.6	20.6	38.3	621
5-6	1.9	1.3	7.9	16.3	18.2	19.6	34.8	300
>6	18.7	17.0	16.5	15.1	12.0	10.5	10.2	185
All Households	6.1	11.1	9.3	12.2	13.9	18.7	28.7	1920

* Includes "do not know."

population has a greater proportion of households desiring more than six additional children: whereas only 42 per cent of the plantation population with more than five children want more than six additional children or leave that "up to God," 54 per cent of the nonplantation population want that many additional children (Table 7).

Among the plantation population, it was possible to discern obvious tendencies towards specification of ideal family size as well as awareness of declining child mortality. In response to the question, "do you believe that children have more chance to live to adulthood than when you were a child?," 88.9 per cent of the plantation population and 63.1 per cent of the nonplantation population answered in the affirmative. This may suggest that the high fertility, which is functional in insuring the desired number of surviving children, is more likely to decline in the future among the plantation population.

Table 8

MEAN PREFERRED NUMBER OF CHILDREN BY AGE OF WIFE, EDUCATION OF WIFE, AND OCCUPATION OF HOUSEHOLD HEAD; PLANTATION AND NONPLANTATION POPULATION

	Plantation Population			Nonplantation Population		
Characteristics	**<30 years**	**30 & over**	**All house-holds**	**<30 years**	**30 & over**	**All house-holds**
Marriage Type						
Monogamous	6.5	6.0	6.2	7.4	7.8	7.6
Polygamous	7.8	7.2	7.5	8.2	7.4	7.8
Education						
No formal education	7.8	7.4	7.6	8.4	7.4	7.9
Primary	7.7	7.2	7.5	7.6	7.3	7.5
Secondary	6.2	6.1	6.1	6.3	6.2	6.3
Higher	6.0	5.7	5.9	5.6	6.0	5.8
Other	5.3	5.1		5.4	5.0	5.2
Work Status of Wife						
Working wife	6.2	6.1	6.1	7.3	7.0	7.2
Nonworking wife	8.3	7.0	7.7	8.8	8.2	8.5
Husband's Occupation						
Farming/ trading/fishing	—	—	—	8.9	8.4	8.6
Skilled	7.3	7.2	7.1	8.6	8.0	8.3
Unskilled	7.1	7.3	7.1	7.7	7.1	7.4
White collar	6.9	6.5	6.7	7.2	6.9	7.0
All Households	6.8	6.2	6.4	7.4	7.2	7.5

Considering the mean for all households, the nonplantation population wants larger families than the plantation population, controlling for socioeconomic level (Table 8). Cohort differences in attitudes toward family size are very slight, though younger wives want more children among the plantation population. This implies that the socioeconomic factors may not have acted strongly among the plantation population so as to change preferences of the young wives compared to those of their mothers, although preferences vary considerably more (comparing row values) than among women not exposed to the plantation economy.[22] This may be related to the effects of greater education and working among plantation wives.

2. *Child spacing*

Modernization is held to influence child spacing by leading people to prefer longer spans between childbirths. But in traditional society, with no developmental influences and no family planning information, child spacing will be a function of customs and traditions, including sexual taboos after child birth and weaning customs. The weaning period is between one-and-a-half and two-and-a-half years in most traditional societies in Nigeria.[23] [24] Sexual relations during this period are considered harmful to the health of the child, so the average childbearing interval has been about three to four years even without modern contraception. This results in the lactation taboo of two to three years plus one year for conception and delivery.

The average ideal childspacing duration among the plantation population is shorter than for the nonplantation population (Table 9). The plantation population tends either to have less faith in the traditional belief in long periods of postnatal abstinence or to have experienced a disassociation from traditional notions of the benefits of childspacing through prolonged postnatal lactation and abstinence. Some inferences can be made from household living arrangements: whereas more than 40 per cent of the nonplantation population have separate living facilities for wives and husbands, housing facilities in the plantations make it difficult to maintain the "expected" traditional physical separation of husbands and wives.

The shorter desired birth intervals among the plantation population, which can come about only from the reduction in the duration of breast-feeding and postnatal abstinence, suggests the presence of new cultural processes influenced by the changed socioeconomic situation. In addition to new housing patterns, possible influences include education, exposure to the influence of Christianity (which opposes polygamy) and the changing role of women mirrored in higher employment of the young and educated women in the formal sector.

If we take a desired one- to two-year birth interval as an indication that a couple does not believe in the intercourse taboo, it appears that the tradition has declined slightly among the plantation population: about 53.4 per cent of the wives in the plantation population as opposed to 45.9 per cent in the nonplantation group, consider one to two years a preferred and acceptable birth interval (see Table 9). Levels of education here appears to be a major factor.

Women in both groups with education at or above the secondary level were twice or three times as likely to choose a one- to two-year interval than the

Table 9

PERCENTAGE DISTRIBUTION OF STATED IDEAL BIRTH INTERVAL BY LEVEL OF EDUCATION—PLANTATION AND NONPLANTATION POPULATION

Birth Interval	No Education	Primary	Secondary	Higher	Percentage
Plantation Population					
1-2 years	41.6	54.5	62.5	72.5	53.4
3-4 years	55.1	43.2	36.1	27.3	44.0
5 years +	2.3	0.5	—	—	0.5
Do not know	1.0	1.9	1.4	0.2	2.1
Non-Plantation Population					
1-2 years	36.2	58.4	60.1	68.5	45.9
3-4 years	55.5	39.2	38.5	26.4	51.3
5 years +	0.8	0.3	—	—	0.3
Do not know	7.5	2.1	1.4	5.1	2.2

Table 10

FERTILITY RATES—PLANTATION AND NONPLANTATION POPULATION (BASED ON BIRTHS DURING THE 18-MONTH PERIOD PRIOR TO THE SURVEY)

	Plantation Population		Nonplantation Population	
Age of Wife	Rate	No. of Women	Rate	No. of Women
15-19	.351	106	.317	112
20-24	.321	232	.358	205
25-29	.294	677	.295	573
30-34	.233	550	.245	507
35-39	.152	339	.173	311
40-44	.105	148	.107	152
45-49	.021	64	.034	60
Total	0.245	2116	0.268	1920
Standardized for age	0.241		0.252	
Ig	0.543		0.587	

customary three- to four-year interval. In contrast, the majority of uneducated women chose the three- to four-year interval, with some preferring an even longer interval. On the whole, the nonplantation households were more traditional in their child-spacing preferences than the plantation households.

Project Effects on Fertility and Fertility Differentials

Both the plantation and nonplantation populations show high levels of fertility (Table 10). Rates are consistently high up to age 35, with the 20 to 24 year age group being the most fertile. Among those under 25, fertility is higher among the plantation population, but the gradient of decline after that age is steeper than that of the nonplantation population. The overall marital fertility (Coale's index, Ig) of the plantation population is only slightly lower than that of the nonplantation when standardized for age. As for children ever born, nonplantation fertility is higher than that of the plantation population, but the difference of 9.3 per cent, declines to 5.4 per cent when standardized for age (Table 11).

Despite the problem of memory lapse and reluctance to remember/report dead children, the relatively low proportion of surviving children suggests a high incidence of infant and child mortality in the two samples. But whereas at the end of their reproductive lives nonplantation women would have lost 30 per cent of their offspring, plantation women would have lost only 21 per cent.[25]

The marriage duration-specific fertility levels do not differ markedly from the age-specific fertility levels when standardized for age and hence are not presented here.

Attempts also were made to explain fertility differentials by different socioeconomic factors. The table showing mean children ever born per type of marriage is not presented, but it was clear, as in other studies, that fertility was slightly higher for women in monogamous households, even controlling for age and duration of marriage. Overall, the situation showed a CEB of 3.2 and 3.6 for the monogamous plantation and nonplantation population; and 3.1 and 3.4 for polygamous plantation and nonplantation population, respectively.

The strong influence of women's education is suggested in Table 12. As observed in Table 8, there is a clear relation between education and fertility. Even though the pattern is curvilinear in both samples, levels in the plantation population lie below those of the nonplantation population.

It is interesting to note that the participation of housewives in nonfarm jobs was associated with lower fertility in both samples, though occupational differentials were not very large. The same was observed with respect to income when controlling for age of household head. Clearly education, employment status, and income are not unrelated, so these two-way differences must be considered only suggestive.

Table 11

MEAN NUMBER OF CHILDREN EVER BORN AND LIVING CHILDREN PER MARRIED WOMAN, BY AGE—PLANTATION AND NONPLANTATION POPULATION

	Plantation Population			Nonplantation Population		
Age	Children ever born	Living children	Proportion of children surviving	Children ever born	Living children	Proportion of children surviving
15-19	1.1	0.7	.81	0.7	0.6	.84
20-24	1.6	1.2	.85	1.6	1.3	.84
25-29	2.5	2.2	.86	2.8	2.3	.83
30-34	3.5	2.8	.80	4.1	3.0	.75
35-39	4.4	3.6	.79	4.6	3.6	.74
40-44	5.0	3.7	.70	5.3	3.7	.70
45-49	6.3	3.8	.68	6.1	4.0	.65
ALL	3.1	2.5	.79	3.4	2.6	.70

Table 12

MEAN NUMBER OF CHILDREN EVER BORN BY AGE AND EDUCATION OF WIFE PLANTATION AND NONPLANTATION POPULATION

	Plantation Population			Nonplantation Population		
Age	No formal Education	Primary	Secondary/ technical or higher	No formal Education	Primary	Secondary/ technical or higher
15-19	1.0	1.0		0.7	0.6	
20-24	1.4	1.6		1.8	1.8	
25-29	2.7	2.7	2.5	2.8	3.2	2.6
30-34	3.9	3.8	3.4	4.1	4.3	3.5
35-39	4.6	5.5	4.9	4.9	6.4	6.5
40+	5.6	5.4	5.2	6.1		
Total	3.4	2.8	2.7	3.6	2.9	2.8
Standardized for age	3.4	3.1	3.0	3.6	3.3	3.2

Table 13

WIFE'S KNOWLEDGE AND PRACTICE OF CONTRACEPTION BY AGE (PERCENTAGE)

	KNOWLEDGE[1]		PRACTICE[2]	
Age	Plantation Population	Nonplantation Population	Piantation Population	Nonplantation Population
15-19	9.5	7.2	0.2	0.0
20-24	9.9	5.8	0.7	0.4
25-29	13.5	12.7	6.4	0.8
30-34	14.1	13.3	13.5	1.8
35-39	15.7	13.8	12.5	4.2
40-44	16.2	14.6	8.3	2.7
ALL	13.5	12.9	11.2	8.3

[1]The question was "Have you ever heard of a woman or man doing something to deliberately delay or prevent a pregnancy?"

[2]"Have you ever used any of the following methods to delay or stop pregnancy?"
1. Tablets 3. Foam 5. Traditional methods 7. Injection
2. Durex 4. IUD 6. Withdrawal

Project Effects on Knowledge and Practice of Family Planning

In both the plantation and nonplantation areas, family planning facilities and services are available on a voluntary basis in all rural health centres, maternity centres, maternal and child welfare services, and at hospitals. When attending any of these facilities, women are always informed of their availability and advantages by trained community nurses and midwives and social welfare and health workers. Problems related to "short-supply"—that is, people who seek services not available—are rarely reported.

Despite the availability of contraceptives, both populations have very low levels of knowledge and usage. Knowledge and usage are greater among the plantation group than the control group (Table 13); 11.2 per cent and 8.3 per cent, repectively, ever used any contraceptive method. Age is a significant factor in both groups, with younger women more likely to use birth control. Traditional methods and withdrawal are the most common methods used among both groups, although condoms also are used by a fifth of plantation couples. All methods—even traditional—are used more by the plantation population. Withdrawal and other traditional methods have been used by 15 per cent of the plantation population while modern methods (condom, pill and IUD) were

Table 14

MEAN LENGTH OF BREAST-FEEDING IN MONTHS BY MOTHER'S EDUCATION— PLANTATION AND NONPLANTATION POPULATION

Education	Plantation Population	Nonplantation Population
None	12.3	18.5
Primary	11.3	14.1
Secondary/Technical/Vocational	6.7	7.4
Higher	6.3	6.6
All	8.1	13.7

Table 15

ATTITUDES OF WIFE TOWARD BIRTH CONTROL

	Plantation Population		Nonplantation Population	
Attitude	No.	Percentage	No.	Percentage
Approve (Yes)	635	30.4	198	10.3
Disapprove (No)	1162	54.5	1515	78.9
Uncertain (No response)	319	15.1	207	10.8
Total	2116	100.0	1920	100.0

ever-used by only 6 per cent. In an earlier discussion, we referred to the intercourse taboo period during breast-feeding as an important factor in child spacing. Our survey results show that irrespective of educational level, the nonplantation women breast-feed their children longer than the plantation women (Table 14). This means that they would actually have lower fertility than plantation women if it were not for other differences.

When asked whether they approved of birth control, the plantation population responded affirmatively more often (30 per cent versus 10 per cent). When comparing Tables 15 and 13, it looks as if most of those who approve of contraception also have used it, because the percentages of those approving the practice are not much higher than the percentages of those professing knowledge.

Table 16

PERCEIVED BENEFITS OF CHILDREN BY PERCENTAGE OF HOUSEHOLDS— PLANTATION AND NONPLANTATION POPULATION

Range	Plantation Population	Nonplantation Population
Scores on Perception-Utility Scale		
0 (least useful)	2.4	0.6
2 or 3	2.8	0.9
4 or 5	19.4	1.4
6 or 7	31.9	21.4
8 or 9	25.2	44.1
10 - 12 (most useful)	17.5	24.3
No response/don't know	0.8	7.5
Scores on the Cost Sensitivity Scale		
0 (least cost conscious)	1.4	0.1
1	11.3	0.5
2	32.4	8.6
3	39.0	57.2
4	9.0	17.1
5/6 (most cost conscious)	6.5	16.0
No response/don't know	0.4	0.5

Project Effects on the Cost and Value of Children

Based on perception-utility (P-U) and cost sensitivity (C-S) scales devised by Mueller[26], some measures were derived to capture the perceived net economic benefits of children in the two samples. The scores on the perceived utility scale range from 0 to 12 depending on how beneficial children were considered. The control group was somewhat more likely to perceive children as generally beneficial. Ninety per cent of the control group as opposed to 75 per cent of the plantation group had scores of six or above on the P-U scale. The points for the perceived cost range between zero if no economic costs were perceived and six if these costs were prominent. About 45 per cent of plantation household heads thought children were not very costly to rear compared to less than 10 per cent of the control group (Table 16). These responses had marked variations by socioeconomic and income group. Basically, the plantation population behaved as a more urban population, judging from Mueller's [27] and Uyanga's[28]

earlier studies on this topic.[29] Moreover, the plantation population tended to value children more for noneconomic reasons—often more for love, happiness, and psychological benefits. Their responses showed that children are perceived to be more useful as citizens rather than as productive agents within the household. The nonplantation households thought more of the progenital and economic benefits of children. In fact, it was common for them to observe failure to conceive as an immense tragedy and infertility a social disgrace.

CONCLUSION

During the 20 years of operation, the Cross River plantations have generated some demographic changes. Above all they have encouraged in-migration, but they have not affected population redistribution on a large scale because of the rapidly growing urban alternatives in the country, including those in Cross River state and the eastern region.

Through their modernizing and rural development influences, the plantations seem to have played a part, though a limited one, in changing the attitudes of plantation members towards the benefits of smaller families and reduced fertility. The level of family planning and conscious childspacing is, however, still very low. However, the role of plantation midwives and health workers, the effects of nontraditional female employment, and expansion of rural higher education may be contributing to ongoing attitudinal changes.

The higher the income of the *nonplantation* rural households, the greater the probability of desiring additional children, of attaching high value to large families, and of marrying more wives. On the other hand, among the plantation population, higher earnings and education are associated with marrying later, monogamy, and some notion of preferred family size. But perhaps owing also to their relatively better health and nutrition and their reduced traditional postpartum abstinence and lactation, their fertility continues to be high. However, because of their more favourable attitudes, family planning may become more likely to be accepted and used by plantation women.

There are several other findings of policy interest. For instance, even though the household head makes decisions affecting the economy of the household, in most cases he does not make the decision concerning the number of children to be born. Most wives do not appear to have the knowledge or will to make these decisions either. Thus to a considerable extent, the decisions about childbearing continue to be largely "nondecisions." Children just "happen" and are considered part of the natural way of things.

In situations where the wife approved of family planning, particularly on plantations, there were indications that she made the decision about how many children to have. However, it is uncertain that the wives who approved of family planning and who also make fertility decisions always wanted to have fewer children. In a rural milieu, where a woman's status is closely related to the number of children she has, the fact that a woman makes the fertility decisions and wants family planning does not necessarily imply a desire for fewer children. Plantation women more often appeared to desire more control over *when* to have their children more than anything else. Also, among the plantation popula-

tion, desires for fewer children were associated with higher incomes, better jobs, and improved nutrition and sanitation.

The policy implication here is that a family planning programme based on a narrow perspective of contraceptive technology would have little impact on rural fertility in the area. For a family planning programme in rural Nigeria to be effective, it should be comprehensive, providing not only a full range of maternal and child health services but also nontraditional employment opportunities for rural women.

Another observation of policy interest concerns migration into the plantation projects. Further in-migration should be encouraged not only as a vehicle of social change in the area, but also because there is some evidence that in-migration of younger women is higher than for the preceding generation. These young women (married already or who marry on plantations) may exhibit an estrangement from traditional family formation norms, which can eventually result in their having lower fertility. To the extent that young migrants identify with their parents' ideals, there will continue to be high rural fertility, which may even increase as health and nutrition improve. But to the extent that plantation workers feel there is a possibility of upward mobility (economic and social), a resulting decline in fertility may become more likely.

NOTES

Chapter Five

1. I am grateful to the Rockefeller Foundation for funding this project; to the Carolina Population Center of the University of North Carolina at Chapel Hill for perfecting the research instruments; and to the University of Calabar for thoughtfully administering the grant.
2. Hancock, W.K., *Survey of British Commonwealth Affairs,* v. 2, part 2 (Oxford: Oxford University Press, 1942).
3. Nicol, M., "Fertility and Food in Nigeria." *West African Medical Journal,* v. 1, n. 8, 1949, pp. 18-27.
4. Partridge, C., *The Cross River Natives* (London: 1945).
5. Nicol, M., "Fertility and Food."
6. Coale, Ansley, J., "The Decline of Fertility in Europe from the French Revolution to World War II." In S.J. Behrman, et al. (eds.) *Fertility and Family Planning* (Ann Arbor, MI: University of Michigan Press, 1969).
7. Edkanem, I.I., et al., "The Role of Traditional Birth Attendance in the South Eastern State of Nigeria." Institute of Population and Manpower Studies, Research Report No. 4. (Nigeria: University of Ife, 1975).
8. McKeown, L., *In the Land of the Oil Rivers* (London: 1948).
9. Jeffreys, M.D.W., *Historical Notes in Ibibio Native Languages and Societies,* Mimeo (Nigeria: University of Calabar, 1931).
10. Johnston, H., "The Bantu Borderland in Western Africa." *Proceedings of the Royal Society of Geographers,* v. 10, 1888 p. 635.
11. Talbot, P., "The Land of the Ekoi, Southern Nigeria." *Geographical Journal,* v. 36, 1910, p. 638.
12. Forde,, Daryl., "Land and Labour in Cross River Village." *Geography Journal,* v. 90, 1937, p. 24.
13. Calabar is the capital of Cross River State, which is on the coast in the southeast corner of Nigeria bordering Cameroon. The approximate populations of Calabar City and Cross River State, at the time of the survey, were 446,033 and 5.6m., respectively.
14. Simon, Julian L., *The Effects of Income on Fertility.* Monograph 19 (Chapel Hill, NC: Carolina Population Center, University of North Carolina, 1974.)
15. Becker, Gary S. and H. G. Lewis., "On the Interaction between the Quantity and Quality

of Children." In Theodore W. Schultz (ed.) *Economics of the Family, Marriage, Children and Human Capital* (Chicago: University of Chicago Press, 1974).

16. See Mueller, E. and D. Freedman. *A Multipurpose Household Questionnaire* (Washington, D.C.: World Bank and U.S. Agency for International Development, 1975). ED.
17. This extended discussion of wording to be used in the survey was not contained in the author's original report, but was conveyed to the editors in later correspondence. We feel it contains many useful points and is a vivid reminder of the perils of cross-cultural survey research. ED.
18. The sample frame thus excluded the privately owned plantations. ED.
19. This may explain why the non-response rate was less than one per cent. ED.
20. Lucas, David., *A Demographic Study of a Southeastern Ibibio Village.* Human Resources Research Unit, Research Paper No. 6 (Nigeria: University of Lagos, 1974, p. 10).
21. Udo, R.K., "Sixty Years of Plantation Agriculture in Southern Nigeria." *Economic Geography,* v. 41, 1965, pp 356-368.
22. The one notable exception is education: controlling for education, differences disappear. This suggests to us that the higher education facilitated by the convenience of on-site plantation schools is indeed having an effect on reducing desired family size. ED.
23. Caldwell, Pat and John C. Caldwell., "The Function of Child Spacing in Traditional Societies, and the Direction of Change." Paper presented at the Workshop on Child Spacing in Tropical Africa, Brussels, April 17-18, 1979.
24. Oruboloye, I.O., "Child-Spacing among Rural Yoruba Women of Ekiti and Ibadan Division of Nigeria." Paper presented at the Workshop on Child Spacing in Tropical Africa, Brussels, April 17-18, 1979
25. These computations assume a stationary population, with constant mortality. ED.
26. Mueller, E., "Economic Cost and Value of Children to Parents." In James F. Fawcett (ed.), *Psychological Perspectives on Population* (New York: Basic Books, 1973).
27. Ibid.
28. Uyanga, J., "Economic Determinants of Urban Family Size: A Case Study of Calabar." *Nigerian Behavioural Sciences Journal,* v. 1, n. 1, 1978.
29. However, it would appear that the views regarding *cost sensitivity* of the plantation population are relatively non-urban, perhaps reflecting the fact that schooling and health care are provided free to children living on plantations. ED.

Additional References

Acsadi, Gyorgy T., et al., n.d., "Surveys of Fertility: Family and Family Planning in Nigeria. Institute of Population and Manpower Studies, Research Paper No. 2. (Nigeria: University of Ife).

Caldwell, Pat and John C. Caldwell, "Factors Associated with the Development of Low Fertility: A History Summary." United Nations: *Proceedings of the World Population Conference,* v. 11, 1965, pp 205-209.

Caldwell, Pat and John C. Caldwell, "Estimates of Fertility and Mortality in Tropical Africa." In C. Okonjo and John C. Caldwell (eds.), *The Population of Tropical Africa* (New York: Columbia University Press, 1968).

Easterlin, Richard A., "The Economics and Sociology of Fertility: A Synthesis." In Charles Tilley (ed.), *Historical Studies of Changing Fertility* (Princeton: Princeton University Press, 1978).

Eden, E., "A Brief History of Efut People." Unpublished, 1947.

Harding, H.J.M., "The Bamenda Cross River Calabar Scheme." *Farm and Forest,* v. 4, 1952, pp 10-14.

Ministry of Economic Planning., *Housing Enquiry.* Statistics Division, Calabar, pp 18-31.

Nigeria, Federal Republic of., *The Pre-Feasibility Report of the Cross River Basin* (Lagos, Nigeria: Ministry of Agriculture, 1952).

Stokes, C.S., W.A. Schutjer, T.L. McCoy and C.H. Wood., *Rural Development, Land and Human Fertility: A State of the Arts Paper* (Washington, D.C.: U.S. Agency for International Development, 1979).

Wallace, J.W. "Agriculture in Abakiliki and Afikpo." *Farm and Forest,* v. 2, 1950, pp 90-101.

THE DEMOGRAPHIC DYNAMICS OF A FRONTIER AREA: THE STATE OF RONDONIA, BRAZIL

Maria Helena F. T. Henriques[1]

In this chapter we describe the demographic and related effects associated with two large colonization projects in frontier Brazil. The projects are located in the state of Rondônia in the Amazon basin of western Brazil. Household surveys were undertaken in the two project areas in 1980 to assess the living conditions of the settlers.

This chapter is divided into six sections. The first provides background information on recent Brazilian government population redistribution policies, on the state of Rondônia, and on the settlement projects themselves. In the second section, we describe the data collection procedures used in the socio-demographic survey. The third and fourth sections cover the settlers' migration patterns and socioeconomic characteristics. In the fifth section, we examine their mortality, fertility, and migration intentions, and in the last section, we advance some hypotheses about the future of the settlers and the colonization projects.

We hope the information presented will both add to the knowledge about development projects in the region and stimulate debate on the applicability and effectiveness of social policies in the Amazon, especially the Directed Colonization Program.

BACKGROUND

Brazilian Frontier Settlement

In an attempt to classify the contemporary frontier movements in Brazil, Merrick and Graham[2] stated that there were at least four distinct frontier patterns in recent Brazilian history: the Paulista-plantation-immigrant pattern, the new coffee frontier pattern in Paraná, the westward frontier movement, and the directed colonization policy in the Amazon.

The first pattern, the Paulista-plantation-immigrant pattern, lasted from 1885 to 1930. It developed out of the coffee expansion in São Paulo which generated the heavy foreign immigration stream of the nineteenth century, settlement of the southeastern part of the country, and the beginnings of modernization in Brazil. Large holdings, as well as middle-sized properties formerly devoted to subsistence agriculture, were planted in coffee. Planters were of mixed background, including small and large landowners as well as merchants. They devoted themselves entirely to their land, borrowed money and invested it. For

the first time in Brazilian history, land was regarded as capital. Coffee growing led to major economic and social changes. Railway lines multiplied more than four times during the period due to the need to transport the new commercial crop, coffee,[3] to the coast. Increasing exports provided favourable conditions for the rise of urban centres and financial expansion. As Redwood put it,

> . . .the exportation of coffee helped to provide both the capital and the financial system which would later spur the industrialization of São Paulo and the port of Santos provided an important transportation infrastructure which would later be used for the conveyance of raw materials and agricultural goods to the city and facilitate the distribution of manufactured products outward from it.[4]

When coffee exports declined in the 1930s, landowners reduced production and re-shaped the direction of development. Rural-to-urban migration increased as the *fazenda* workers lost their jobs on the plantations and moved to find jobs in new industries.

The second frontier pattern, the new coffee frontier, lasted from 1940 to 1960 and was located in Paraná. While also coffee oriented, it strongly differed from the Paulista pattern in its economic organization. The settlement process in the area occurred through the initiative of a British company which bought 12,643 square kilometres in northern Paraná to subdivide into small plots. The company sold the individual plots, promoted diversified agriculture and built basic infrastructure including towns, highways, and a rail connection to São Paulo. The enterprise was sold to Brazilian capitalists in 1944, and has been described by Nicholls[5]. The success of the enterprise was directly linked to the previous development which the neighbouring areas of Rio and São Paulo had experienced. These areas were densely populated by groups of people with the purchasing power to provide markets for the foodstuffs produced on the plots. Also, commerce was aided by the infrastructure of railroads, highways, credit, and financial institutions already in operation.

The economic and population growth that occurred in the area was without precedent in Brazilian history. Paraná became the place of destination for migratory flows to both rural and urban areas. The type of land tenure system that was implanted accommodated many rural workers for many years to come and it was only in the 1970s, through changes in land use, that Paraná's rural labour force suffered.

The 1960s constituted a landmark in the direction of increasing Government control over the development process in Brazil. A series of public policies, including the creation of the new capital, Brasília, in the interior and the opening of long highways connecting regions of the country (such as the Belém-Brasília, the Cuiabá-Porto Velho, and the Transamazon), were begun under the labels of "national security," "occupation of empty spaces," and "linking of the landless men to the menless land." The agricultural frontier expanded to incorporate millions of acres of new land. The direction of the movement was westward to Goiás and Mato Grosso, unlike previous frontier expansion.

Commercial crops were not introduced at the beginning, with wood extraction and subsistence agriculture dominating as poor peasants entered the area seeking land. The highway built by the Federal Government, however, served as a channel for commercialization of staples grown on the frontier, which were sent to southeastern urban markets. Agriculture, based on rice, corn, beans, and coffee, flourished and regional cities such as Goiánia and Anápolis developed.

This third, central-west movement differed from the earlier São Paulo and Paraná movements in at least two basic respects: the Government rather than private capital took the leadership, and the urban component was more important. The social class and states of origin of migrants to the three frontiers were also different. On the Paulista frontier, foreign immigrants played a major role. On the Paraná front, 33 per cent were born in São Paulo, 22 per cent in Minas Gerais, 14 per cent in Rio Grande do Sul, 12 per cent in Santa Catarina, and 6 per cent in Bahia. Of migrants to the central west, 35 per cent were natives from Minas Gerais, 16 per cent from São Paulo, 13 per cent from Bahia, 8 per cent from Maranhão, 5 per cent from Ceará, and 16 per cent from other states of the north or northeast regions[6]. Therefore, while more than three-fifths of migrants to Paraná came from the richer areas of the South and brought capital with them, approximately four-fifths of the Central-West migrants were deprived peasants coming from the poor north and northeastern areas of the country.

The fourth frontier was opened in the 1970s. Here public investments were the rule, typified by the Transamazon Highway and the Colonization Policy, a part of the "Programa de Integração Nacional" (PIN or National Integration Program). The highway network had three parts: the Transamazon, the Cuiaba-Porto Velho and the Belém-Brasília highways. The goal was to provide access to fertile Amazon land which could be cultivated to feed the urban population of the more developed areas of the country, and to act as a safety valve to ease pressures on land in the most densely populated areas of the rural Northeast. The PIN's main objective was to reduce regional imbalances and decentralize development through the creation of new growth centres. The State not only put forward these objectives but, through a series of Decrees, created the legal conditions to achieve these goals.

> It defined a priority area along the Transamazon Highway for agrarian reform; created the Regional Department of INCRA (National Institute for Settlement and Land Reform); determined that the agrarian reform projects should include 100,000 family units; called for the organization of 100 cooperatives, studies on the socioeconomic conditions of the area, and a technical reference file for the region; called for the redefinition of rural landholding titles in favor of squatters actually occupying the land; and, finally, stated that the resources for the whole enterprise should be provided by INCRA and PIN.[7]

The application of this policy in the area freed for expropriation 6.5 million hectares in the priority zone and 2.2 million square kilometres in a 100 kilometre

wide strip on either side of the highways in the Amazon Region. Basic services were to be provided for the settlers by several federal agencies. INCRA was responsible for the demarcation and provision of the lots, construction of modest houses and the agrovilas (rural towns), and furnishing education and health care until the proper agencies could take over the latter. The Associacão de Crédito e Assistência Rural would give assistance in technical matters. The Bank of Brazil would provide credit at low interest rates, while Companhia Brasileira de Armazenamento would guarantee a minimum price and the storage of produce. The Companhia Brasileira de Alimentos would distribute food to the settlers at low cost, and Servico Especial de Saúde Pública would operate mobile medical care units. The Superintendência do Control de Malâria was in charge of malaria control. The financing of all these activities was to be made by a transfer of 30 per cent of all fiscal incentives to PIN.[8] Last but not least, the production units would be 100 plots aimed at both subsistence and commercial crops.

The INCRA settlement target for the 1971-1974 period was 100,000 families; by 1974, however, it had succeeded in settling only 5,717 families in the Marabá, Altamira, and Itaituba projects.[9] Aside from the infrastructure which was never implemented, the most serious failure was in the system designed to support agricultural production. This included inadequate seed, settler indebtedness, lack of means of transportation, insufficient storage facilities, and difficulties with credit. In analyzing the history of the Transamazon projects it is thus clear that

> . . . to a large extent, low agricultural productivity in the first years of the colonization project was attributable not to a failure on the part of the colonists to produce, but to the inadequate functioning of the systems designed to support production and commercialization. In 1975 and 1976, great expansion in rice production among both official colonists and spontaneous settlers in the Marabá region demonstrated their productive capabilities.[10]

In the mid-1970s Government policies changed. Emphasis on social goals was replaced by economic concerns. Colonization in the Amazon was evaluated as a failure and large enterprises were invited to help in developing the region. This led to the establishment of 500 to 3,000 plots, supposedly to attract large joint capital agricultural and livestock enterprises, foreign and national, to the Amazon. As a consequence land rose in value and became an object of speculation. Invasions of squatters on private lands and Indian reservations became common.

What happened to the peasants who needed the land for survival? Most of them left their lots (in 1980, 60 per cent of the project lots did not belong to their original owners) or sold them, even though this is illegal according to project rules. Many who stayed became share-croppers or were involved in leasing or piece-work contracts.

From a technical point of view, the settlement of 100,000 families by 1974 was a totally unrealistic goal. But a complex operation such as the planned

scheme could hardly be evaluated after just three or four years of operation. Blaming the small farmer for the failures just when the project was beginning to be a success was a consequence of pressures from more powerful interests. Thus the evaluation of the experience, instead of involving a serious critique of the policy and its administration, served to eliminate the small farmer from playing any role in the future development of this part of the Amazon region.

Rondônia: The Last Frontier

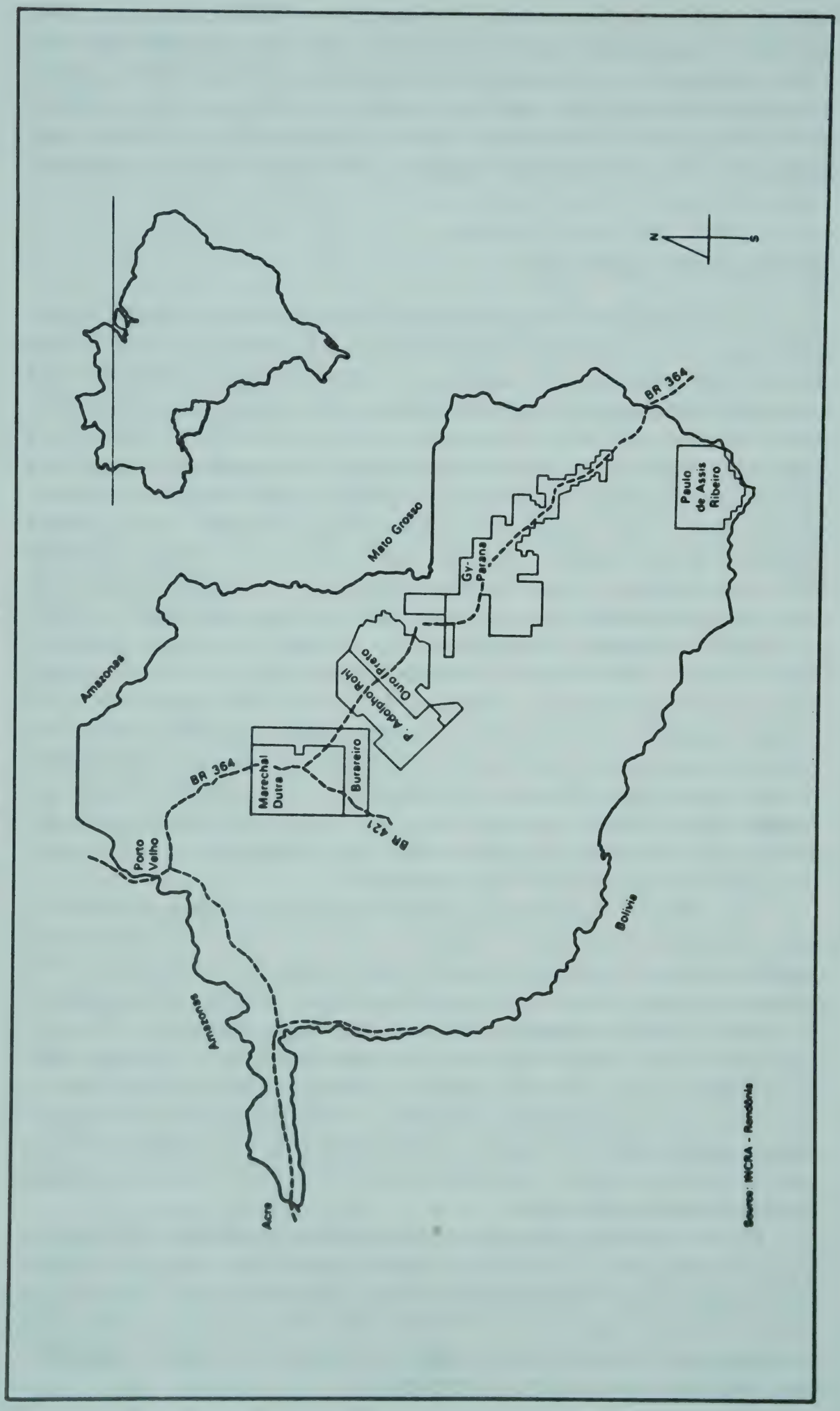
In the second half of the 1960s, the Federal Government started heavily advertising the availability of land in Rondônia. The campaign was focused on areas of high rural population density and those with severe conflicts over land ownership. The slogan, "let us link the landless men to the menless land," helped attract migrants, the first of whom settled along the new BR-364 Highway. As these areas became filled, the movement spread to the hinterland, immediately causing conflict with the Indians who were either on their own land or on reservations. Private enterprises started to demarcate and illegally sell land, taking advantage of naive migrants. Conflicts over land became common, and by the 1970s the situation in Rondônia was chaotic. At this time INCRA moved in to co-ordinate land distribution and to establish the directed colonization scheme.

INCRA activities in Rondônia were concentrated at two major levels: the legalization of the land situation in the area (through the Projeto de Asentamento Dirigido and the Projeto de Colonização Integrada). These projects included twelve programmes which were INCRA's responsibility: Land Distribution, Territorial Organization, Administrative Organization, Settlement, Organization of Agricultural Units, Promotion and Execution of Basic Public Works, and Infrastructure. Health, housing, education, co-operative programmes, and assistance in distributing the produce were to be implemented by other government institutions under INCRA co-ordination.

The territorial organization programme has been the most successful, in spite of problems from rising demands for land. It controls land demarcation and distribution as well as the establishment of sites for public services. The programme is quite rigid, however, and has had trouble innovating, especially as regards the most appropriate plot size for efficient production. The other programmes have not been successful, as planning was poor. To begin with, no evaluation of the areas was made to choose the most suitable sites for agriculture. Also, the administrative staff had little interaction with local people and experienced high turnover, and the participation of settlers in planning was absent; they were only called upon to build their own shacks and maintain the dirt roads near their plots.

The infrastructure programme presented the most problems. BR-364, the only connecting road, is badly maintained. Schools and qualified teachers are lacking, and the demand for school places is far above supply. Public health service units are few and most of the time the settlers and their families go to private doctors for poor service at high cost. Crop storage facilities are insufficient and have been a source of curruption.

MAP OF RONDONIA



Credit concessions have not worked as originally expected. INCRA's normal system is that the settler has to own land to qualify for credit, and the application for credit requires specification of crop planning and a timetable for production. A part of the loan is withheld, to be released pending an evaluation of how the first funds were spent. This normal INCRA system was not appropriate for most of the Rondônia settlers; almost none have a clear land title, most are illiterate, and there are not enough credit officials to evaluate how clients spend the first funds, causing major delays in the release of additional funds.[11] In summary, in spite of improvements made to the settlement model that was first attempted in the Amazon, the Rondônia approach still has serious drawbacks.

Today there are seven colonization projects in Rondônia, covering an area of 2,457,997 hectares. The settlement operation is behind schedule in all respects, mostly because demand was severely underestimated. The plan was to have 23,000 families settled by 1980, but even in 1977 there were 30,000 families waiting for plots. Rondônia has experienced tremendous population growth, by over 400 per cent from 1970 to 1980, and was declared a new state in 1979. In 1981, INCRA decided to reduce the size of each plot to 30 ha. to accommodate more people. Even so, plot demarcation is proceeding slowly and the programmes responsible for the implementation of physical infrastructure, credit, technical assistance, and storage have disappeared. Land distribution is very confused,[12] resulting in many social problems. But in-migration continues, despite Government attempts to curb the flow.[13]

The Projects under Study

In an attempt to evaluate the effectiveness of the projects in meeting Government goals and to assess the living conditions of the settlers, we decided to study projects that differed in their degree of institutionalization, Ouro Preto and Gy-Paraná. Ouro Preto, an older settlement with high quality soil, is considered by INCRA to be well-administered. Gy-Paraná, on the other hand, is one of the newest projects, lacks basic services, has poorer soil, and a high turnover of INCRA administrators.

The Ouro Preto Project was the first to be implemented in the region. INCRA selected an area of 157,200 ha. to accommodate 1,000 settlers and their families around 1970. Both numbers were gradually increased as a consequence of growing demand and by 1980 the targets were 500,000 ha. and 5,000 settlers. Plot demarcation and allocation has been well-organized. The plots were originally intended to range from 100 to 200 ha., the latter for cattle raising, but this model was gradually changed with the great majority of plots being 100 ha. plots (and the newer ones usually only 30 ha.). Ouro Preto is crossed by the main BR-364 highway, and has approximately 1,200 kilometres of other unpaved roads. Still, road conditions are very bad, many being impassable during the rainy season. The education and health situation is still quite poor, with the provision of services unable to keep up with mushrooming demand.

The Gy-Paraná Project encompassed an area of 450,000 ha. in 1980, but has opportunities for further expansion as a former contiguous Indian reservation area was recently "liberated" to serve as an additional settlement area.

Gy-Paraná was established in 1972 with 1,000 families and by 1977 had 4,624 families. It is considered the most disorganized of the seven projects in the region: the INCRA administrators for the Project site have had the highest turnover rates; there have been continuous problems with neighbouring Indians; and there is now a labour union starting to organize the settlers to fight for their rights. The quality of the soil is much lower than in Ouro Preto and the use of fertilizers and other corrective inputs is needed to grow temporary and permanent crops. Land productivity and production levels are lower than in Ouro Preto.

Gy-Paraná has a number of urban centres, Cacoal being the most important. However, services for settlers remain extremely poor, especially health and education. Fights over land are common, creating a rather violent environment. In contrast, Ouro Preto has medical facilities and more schools, and is located closer to the state capital (providing better access to some services).

DATA COLLECTION: THE SOCIO-DEMOGRAPHIC SURVEY

Field Work and Sample Design

Our field research was a typical example of learning by doing. Even though we already had good knowledge of the area before undertaking the survey, the physical difficulties involved in the field work imposed a series of changes in the research design. These difficulties are described below.

The research team was comprised of 13 interviewers, plus the principal investigators. Four of the interviewers were men and nine were women. Six worked in Ouro Preto under Henriques and seven in Gy-Paraná under Petruccelli. Interviewers were trained in Rio de Janeiro for two weeks. The coding manual was also prepared in Rio. No pre-test of the survey instrument was undertaken because of the cost of transportation to Rondônia.

The sample selection had to be changed from the original plan because of logistical difficulties. The original plan was to survey a subsample of the group for whom an INCRA Socio-Economic Survey questionnaire had been completed in 1978. We thus hoped to obtain two sets of information for the settler and his family, one from the Socio-Economic Survey of 1978, the other from our own Socio-Demographic Survey. We coded 1,250 questionnaires from the INCRA Survey (a 25 per cent random sample of the total questionnaires). We decided that to be able to reliably estimate fertility rates, we would need a sample of at least 400 in each project. A list of settler families in the two projects, together with some demographic characteristics, was available from the earlier INCRA survey. Information was available on the age of the household head, the number and age of dependents, whether the dependents worked, and the number of years the head had worked since leaving his/her family's household. A complex system of weights was developed that favoured the selection of households where the head was middle aged (33 to 48), had many years of work experience, and had dependents living on the plot, especially working dependents. Then three plots (comprising in each case a settler family and any squatter or *agregado*[14] family encountered on the plots) were to be selected from

each gleba (see below). However, the plots of the initial 400 settlers who had been picked at random from the sample of INCRA respondents were spread all over the large project area. Plots were much too far apart and the interviewing team had only one jeep. Thus, in one day the whole team of six to seven interviewers and a supervisor could conduct only three interviews in a trial run. Hence, a decision was made to interview respondents on all plots in the selected gleba (i.e., accept larger clusters, averaging about ten plots).

The demarcation of plots in all Directed Colonization Projects in Rondônia was as follows, Plots are located diametrically opposed to a line (the name given) to the unpaved road that divides the plots). A set of plots is called a "gleba" and a set of glebas a "POP." There are no *a priori* limits; that is, sizes for POPs and glebas vary. However, there is a certain socioeconomic differentiation at the POP level. The older POPs have better structural conditions because they are closer to the project headquarters, and therefore have better access to schools, roads, credit, and storage facilities. We selected within each POP a number of glebas proportional to the POP's size, and conducted interviews in all plots in the selected glebas.

The field work was carried out during the dry months of June and July, 1980, and lasted for almost two months. Logistic difficulties were overwhelming. During the field work, the National Institute for Colonization and Land Reform (INCRA) provided a jeep, a driver and gas, which got us to the interviewing areas, but thereafter travel was by foot. In Ouro Preto, for instance, we would leave at 6:00 a.m. in the morning and return at 6:00 p.m. in the evening. It took from one and one-half to two hours to reach the entrance to the set of plots to be visited that day, and from there we would split up and go to the individual plots for the interviews. Each interviewer could do only three to four interviews per day. Lunch consisted of fruits picked in the jungle or received from the settlers. We walked long distances to go deep in the forest to find the settlers' shacks. At night, we would have dinner near the project headquarters and discuss the interviews conducted that day. Sometimes it was necessary to use a helicopter to get to some interview sites and to stay the night sleeping on hammocks at the settlers' shacks. The burden was lightened by the warmth with which we were welcomed by the settlers and by comparing our own burdens with their daily difficulties. Nevertheless, half of the interviewing team withdrew before interviewing was completed because of the harsh physical conditions and illnesses.

The Questionnaire

The data collection instrument covered many topics, and the interviews lasted an average of one hour. The questionnaire had both open- and close-ended questions. It was thus not all precoded. It gathered extensive information on the characteristics of the settler and his/her household, including age, sex, marital status, education, occupation, and income of all family members, including children who had left the plot. The migration history of the head was obtained as well as a pregnancy history and recent mortality and morbidity of household members. Attitudes of settlers regarding their experiences and their current status, aspirations, and plans also were obtained. Data on food pro-

duction, including agricultural inputs, access to and use of credit, agricultural extension assistance received, food consumption, housing conditions, and ownership of consumer durables also were obtained.[15]

A few explanatory comments on the questionnaires and their administration may be useful. The usual respondent was the household head, except that the wife was asked to provide the pregnancy history. In practice, the two were usually together at the plot when the questionnaires were administered. In cases where the head was absent, the wife was accepted as a respondent. In the pregnancy history, the woman was asked about her most recent pregnancy first, then the one before, etc., until getting to her first pregnancy.[16]

The general feeling of interviewers was that, despite the length of the questionnaire, it was generally well-understood and answered. There were a few items, however, that presented special difficulties. One was the distance of the plot to the BR-364 highway. Sometimes the plot was so remote that the settler would not know the distance and would use the closest, minor road as a reference. To correct for this, in the coding phase, we used actual distances to the BR-364 road obtained from maps of the area. Another difficulty was in understanding the question on problems or difficulties encountered after receiving the plot. The first reaction of settlers was to answer "none," and only after some insistance from interviewers would settlers offer a different answer. It seems that the settlers day-to-day lives are so problematic that difficulties are taken for granted and not perceived as such. The question on food consumption also presented difficulties, mainly because it was hard to determine amounts even after we established what was consumed. For this reason, we coded quantities only for corn, rice, and beans, and for other items noted only whether it was produced on the plot or purchased.

There were also two important types of economic questions that were difficult for the settlers to answer. The first was the amount of income earned in the previous month. Given that the large majority of settlers consume what they produce or obtain what they need through exchange and rarely deal with money, this question was difficult to answer. In the same way, it proved difficult for settlers to assess the monetary value of the goods in their possession at the time of arrival and at the time of the survey. For this reason, we coded only types of consumer durables, not their values.

Despite these problems, the survey was a very useful instrument for learning about the condition of households in the colonization projects.

THE SETTLERS AS MIGRANTS

Migration Patterns

As mentioned in the introduction, the migratory movement to Rondônia was particularly intense from 1974 onwards. According to available data, the migratory flow was 100 families per month in 1973, increasing to almost 900 per month during 1976. In-migration declined in 1977 due to the police checkpoints established on BR-364 in the southern part of Rondônia, but the flow increased again when people determined how to circumvent the checkpoints.

Table 1

PERCENTAGE DISTRIBUTION OF SETTLERS AND *AGREGADOS* BY YEAR OF ARRIVAL IN RONDONIA, BY SETTLEMENT*

		Up to 1971	1972-74	1975-77	1978-80	Total Number
Ouro Preto	Settlers	23.2	52.7	19.1	5.0	298
	Agregados	14.1	27.3	37.4	21.2	99
Gy-Paraná	Settlers	9.8	41.2	38.7	11.9	318
	Agregados	4.6	21.5	44.6	29.3	65

*Except as noted, the source for this and all subsequent tables is the Rondônia Socio-demographic Survey in 1980.

Data on the date of arrival of settlers and *agregados* to the region are in Table 1, which shows some differences between the two projects. In both settlements, but especially in Gy-Paraná, the *agregados* arrived later than the settlers; three-fourths of the *agregados* in Gy-Paraná arrived after 1975 when more than half of the settlers were already there. This also occurred in Ouro Preto, using 1973 as the reference year. The table shows that settlers and *agregados* arrived earlier in Ouro Preto than in Gy-Paraná. This suggests that the former project might have reached saturation in early plot appropriation to settlers, which could have led to the subsequent rapid increase in the number of *agregados*.

Many settlers had to wait for their plots a long time after arriving in Rondônia. Nearly two-thirds of those who came before 1971 had to wait more than two years for their plots in Gy-Paraná, but as the years went by the waiting period became shorter. In Ouro Preto, the waiting periods had been somewhat shorter from the beginning. The data indicate an acceleration in the process of plot appropriation in both projects. This is reasonable since the first years are the most difficult in terms of organization and administration of the projects. Moreover, improvements in roads and communication systems led, over time, to greater pressures from migrants.

Table 2 shows that the largest percentage of recent migrants came from Paraná and Mato Grosso, though they were likely to have been born in Minas Gerais or northeastern states. There appears to be a multi-stage migratory process to Rondônia, with people originating in the Northeast coming via Mato Grosso and those originating in Minas Gerais coming via Paraná and Mato Grosso (at least those arriving in Ouro Preto). Those coming from Espirito

Table 2

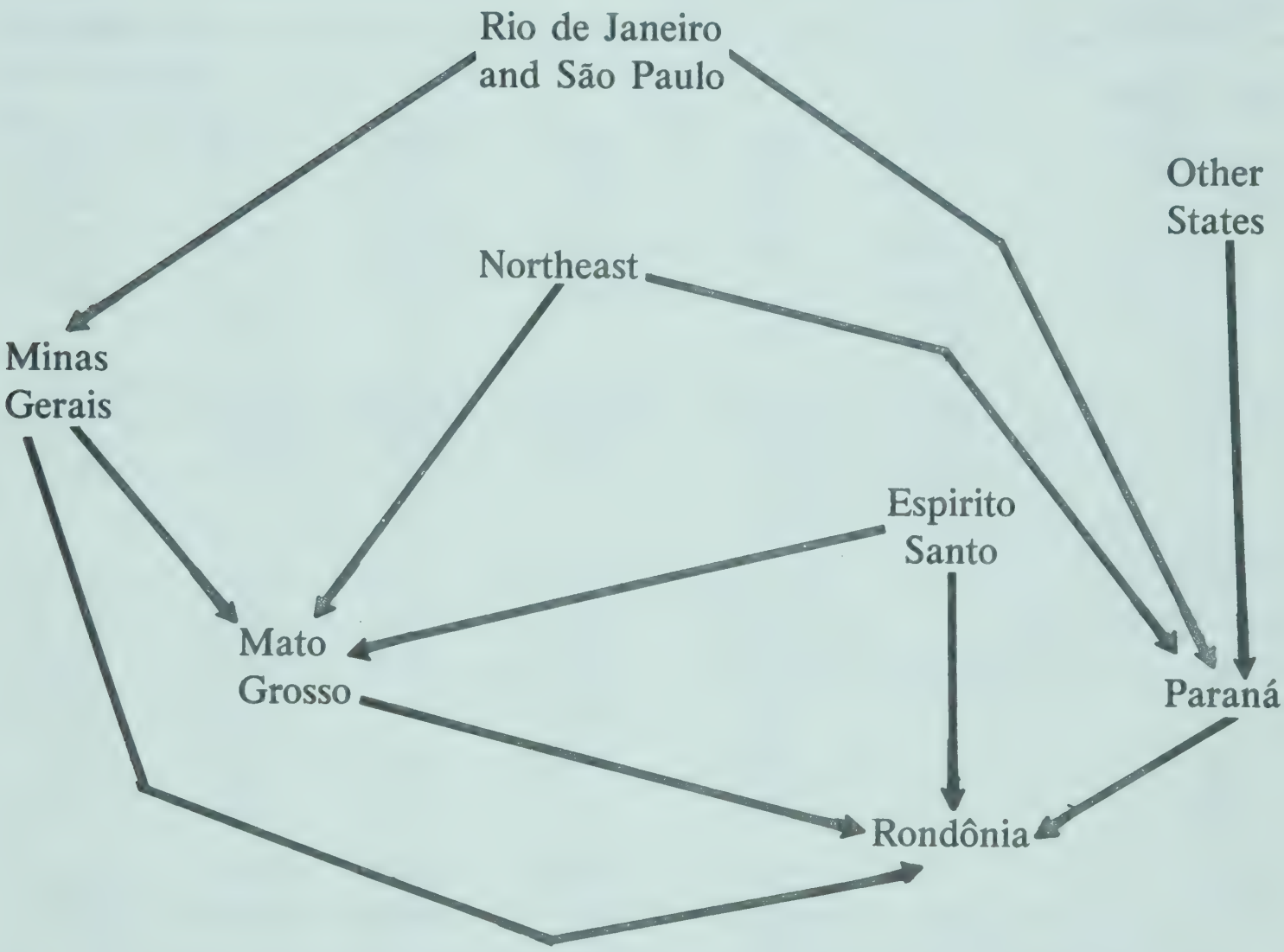
PERCENTAGE DISTRIBUTION OF SETTLERS BY PROJECT AND STATE OF BIRTH, ACCORDING TO STATE OF PREVIOUS RESIDENCE, 1980*

State of Previous Residence	State of Birth					
	Northeast	Minas Gerais	Espirito Santo	Rio de Janeiro & São Paulo	Other States	TOTAL %
Ouro Preto						
Minas Gerais	—	25.6	6.7	6.1	—	12.0
Espirito Santo	1.9	22.1	66.6	3.0	—	18.9
Paraná	20.8	18.6	6.7	27.3	86.6	23.5
Mato Grosso	58.5	29.1	16.7	42.4	6.7	35.0
Other States	18.8	4.6	3.3	21.2	6.7	10.6
Total	100.0 (53)	100.0 (86)	100.0 (30)	100.0 (33)	100.0 (15)	100.0 (217)
Gy-Paraná						
Minas Gerais	—	16.9	2.2	—	—	4.9
Espirito Santo	5.5	6.8	80.0	—	—	19.0
Paraná	29.1	40.7	13.4	42.9	56.2	35.0
Mato Grosso	50.9	35.6	4.4	42.9	25.0	32.7
Other States	14.5	—	—	14.2	18.8	8.4
Total	100.0 (55)	100.0 (59)	100.0 (45)	100.0 (35)	100.0 (32)	100.0 (226)

*Numbers in parentheses are those from the Socio-Demographic Survey. Differences between those reported and the total numbers of settlers (and agregado) households (see Table 12) indicate incomplete or missing data, in this as well as subsequent tables.

Santo, on the other hand, show a different behaviour, most coming to Rondônia directly. In-migrants from Rio de Janeiro and São Paulo usually lived in Paraná and Mato Grosso before arriving in Rondônia. Since Paraná and Mato Grosso represented earlier frontiers, the fact that they have now become sending areas to Rondônia is consistent with the hypothesis that the labour absorption capacity of such frontier areas has declined over time.

The most important migrant flows to Rondônia can thus be depicted as follows:



The push-pull-push process, repeated in each of the frontier settlement periods, constitutes a common type of migratory behaviour. The following table (Table 3), which shows the length of time at previous residence, supports this notion in Rondônia. Of the largest groups of settlers (those from Paraná and Mato Grosso) a third or more had lived at their previous residence less than five years. There were some interesting contrasts, however. Nearly half of the Ouro Preto settlers from Minas Gerais had lived there for more than 30 years before coming to Ouro Preto. Migrants to Ouro Preto stayed on the average 13.4 years in their states of previous residence while those to Gy-Paraná stayed an average of 12 years. The most interesting feature, though, is how the duration of residence in the previous state varies by state. Migrants from recent frontier states (Mato Grosso and Paraná) have much shorter periods of previous residence than those from the traditional out-migration states of Minas Gerais and Espirito Santo. This may highlight the difficulties which frontier settlers face.

Table 3

PERCENTAGE DISTRIBUTION OF SETTLERS BY PROJECT AND STATE OF PREVIOUS RESIDENCE, BY DURATION OF PREVIOUS RESIDENCE

Duration at Previous Residence (in years)	State of Previous Residence					
	Minas Gerais	Espirito Santo	Paraná	Mato Grosso	Other States	TOTAL
Ouro Preto						
Less than 5	7.1	14.3	29.0	38.6	13.3	25.7
6-10	7.1	12.2	20.6	33.0	18.1	23.6
11-20	7.1	42.9	33.9	27.3	36.2	30.4
21-30	32.1	18.4	16.5	1.1	13.3	11.0
31 plus	46.6	12.2	—	—	19.1	9.3
Total	100.0 (28)	100.0 (48)	100.0 (60)	100.0 (79)	100.0 (22)	100.0 (237)
Gy-Paraná						
Less than 5	20.0	36.2	40.1	23.5		32.3
6-10	16.0	25.5	27.1	11.8		22.7
11-20	28.0	33.0	24.7	23.5		28.5
21-30	24.0	5.3	4.7	17.7		10.4
31 plus	12.0	—	3.4	23.5		6.1
Total	100.0 (50)	100.0 (94)	100.0 (83)	100.0 (34)		100.0 (261)

Perceived Conditions at Time of Arrival

In order to learn more about the settlers' reasons for migration and their previous living conditions, we gathered information on their occupation and land use in their previous residence. As seen in Table 4, settlers in Ouro Preto, with higher percentages of both landowners and rural workers, were from a more polarized background than those in Gy-Paraná.

Table 4

PERCENTAGE DISTRIBUTION OF SETTLERS AND *AGREGADOS BY* WORKING STATUS BEFORE ARRIVAL, OURO PRETO AND GY-PARANA

Working Status Before Arrival	Settlers		Agregados	
	Ouro Preto	Gy-Paraná	Ouro Preto	Gy-Paraná
Small landowner	44.1	33.5	16.2	11.9
Tenant	14.2	23.0	16.2	34.4
Agregado	7.5	5.2	20.2	4.5
Sharecropper	3.7	12.7	7.0	10.4
Rural Worker	24.1	18.5	31.3	34.3
Other	6.4	7.1	9.1	4.5
TOTAL	100.0	100.0	100.0	100.0
	(295)	(324)	(99)	(69)

Definitions for the concepts in the table: landowner: person who owns a piece of land, in this case generally small landowners; tenant: person who rents land; agregado: person who has a certain type of working relation with the landowner, generally working for the landowner in exchange for using some land to grow subsistence crops for his family; sharecropper: person who works the land and divides the production with the landowner, in halves, thirds or fourths; rural worker: person who works for a wage, the majority being temporary workers.

Gy-Paraná has significantly more tenant farmers and sharecroppers. *Agregados* in the two projects had mostly been rural workers or tenant farmers (especially in Gy-Paraná), although in Ouro Preto a significant number also were *agregados* previously. Surprisingly, there were a number of previous landowners in both groups. In general, *agregados* appear to have been poorer than the settlers even before arrival, with some 73 per cent being landless in Ouro Preto and 69 per cent in Gy-Paraná.

To sum up, the large majority of settlers and *agregados* that live today in the projects had previously been landless workers, having had to rent land or work on a sharecropping basis or as a wage labourer to survive. By comparing the actual and previous situations of settlers and *agregados,* we note that the same social differentiation that existed at the time of the survey had existed earlier as well.

Useful information was also obtained from a related question—the main reason for leaving the place of previous residence. Among the settlers and *agregados* in both project areas, an overwhelming proportion—three out of five—left because of lack of land. Only 13 per cent, in contrast, left for the

Table 5

MAIN REASON FOR LEAVING PLACE OF PREVIOUS RESIDENCE

	Settlers and *Agregados*	
Reasons	**Absolute**	**(%)**
Lack of land	473	59.1
Came with the family	29	3.5
Lack of money	8	1.0
Lack of work	15	1.9
To improve	105	13.1
Other reasons	129	16.1
Do not know/No answer	42	5.3
Total	800	100.0

usual economic reasons—lack of money or work—though some of the "to improve" responses were undoubtedly based on economics. Land was clearly a key factor in the migration decisions.

A little more than half the settlers came directly to their plots immediately upon arrival in Rondônia, but a considerable proportion of the settlers began their lives in Rondônia as *agregados* (41 per cent in Ouro Preto, 29 per cent in Gy-Paraná). A form of appropriation of plots that is illegal and supposedly non-existent is also evident—the sale of plots: almost one-fifth of the settlers in each project said they had bought their plot.

When asked about the main problems they faced on arrival in the region of Rondônia, settlers and *agregados* manifest important differences between the two projects. For example, diseases are mentioned much more in Ouro Preto, especially among the *agregados*. In Gy-Paraná, respondents indicated the lack of work or land as well as transportation as the most important problems far more than in Ouro Preto. This seems to show differences in perceptions of problems, given the different conditions in the two projects under study. Because Ouro Preto is older, more resources have been put into it, so it has achieved a higher level of infrastructure. As a consequence, it is not that diseases were not important in Gy-Paraná; quite the contrary, but the difficulties perceived as most urgent were instead the more basic ones directly related to the basic material conditions of survival and linked to settlement, production, and commercialization. Thus, health problems only appeared to be more important in Ouro Preto than in Gy-Paraná. (See Section on Health and Housing, below.)

CHARACTERISTICS OF SETTLERS

Age Structure

The vast majority of household heads who were settlers, landowners, and *agregados* were male, 96 per cent in Ouro Preto and 95 per cent in Gy-Paraná. This was partly a consequence of the plot distribution criteria, which was to provide plots to couples; the few women found as heads of households were widows of former plot owners.

The age structure of household heads is similar to that of a migrant population, but a little older (Table 6). This again relates to the criteria for settlers' selection. With respect to individual characteristics of the head, settler or *agregado,* we found the same percentage married in the two projects (93 per cent), as well as similar educational levels (48 per cent did not know how to read or write and only 2 per cent had even an elementary school education).

For the other family members we present the age structure in Table 7. The age structure is younger than that obtained in the earlier Socioeconomic Survey in 1977. The youngest age groups would have been even larger if not for high mortality. Also deserving attention is the abrupt decline in both projects in the proportions for the age group 20-24, reflecting the tendency to leave the plot once adulthood is attained.

Agricultural Work Patterns

Past agricultural experiences of settlers showed they were far from being minifundia (small land holding) planters, with one-third in both projects familiar with cropping 25 ha. or more of land. Their subsequent experience with commercialization channels in Rondônia, however, reflects difficulties they have in selling their produce directly: a middle-man provides the vehicle for commercialization for 70 per cent of the settlers.

According to the earlier 1977 data, agricultural practices in Ouro Preto were more diversified than in Gy-Paraná, through permanent crops as well as pasture. This factor could be linked to the shorter period of operation of the Gy-Paraná project. However, wood extraction, a typical activity in the first years of a project, also existed to a smaller extent in Gy-Paraná. During the 1979/80 agricultural year, the area under cultivation increased, as did the production of the most important crops, in both projects (see Table 8).

Thus, the advantage that Ouro Preto seemed to have in 1977 over Gy-Paraná appears to have disappeared. A similar range of crops was being cultivated in both projects. The most important commercial crops, coffee and cocoa, which started in Ouro Preto, are now also grown in Gy-Paraná, and apparently with greater land efficiency. However, part of the production was lost because of poor management of the harvest.

The financial limitations of settlers and lack of infrastructure have led to the subdivision of plots and the emergence of many *agregados* hired as share-croppers (keeping half or a third of what they produce) or tenant farmers. The *agregados* are part of the itinerant mass of Brazilian agricultural workers

Table 6

AGE DISTRIBUTION OF SETTLERS AND *AGREGADOS* (HOUSEHOLD HEADS), BY PROJECT

(in per cent)

Age Group	Ouro Preto	Gy-Paraná
Less than 20	0.5	0.2
20 - 29	13.8	16.1
30 - 39	23.4	24.4
40 - 49	28.6	30.0
50 - 59	21.1	19.1
60 and over	9.2	9.8
Total	100.0	100.0
	(398)	(396)

Table 7

AGE DISTRIBUTION OF FAMILY MEMBERS OTHER THAN THE HEAD OF HOUSEHOLD BY PROJECT

(in per cent)

Age Group	Ouro Preto	Gy-Paraná
0 - 4	14.3	12.3
5 - 9	17.7	18.0
10 - 14	19.5	20.0
15 - 19	15.9	17.2
20 - 24	8.5	10.2
25 - 29	5.3	4.4
30 - 39	6.0	6.5
40 - 49	4.8	4.6
50 - 59	2.7	2.4
60 and over	5.3	4.4
Total	100.0	100.0
	(2,052)	(2,049)

Table 8

PERCENTAGE DISTRIBUTION OF SETTLERS IN EACH PROJECT BY TYPE OF CROP CULTIVATED, CULTIVATED AREA, AND VOLUME OF PRODUCTION, 1979/1980

Cultivated Area and Volume of Production	Cultivated Crops					
	Corn	Rice	Beans	Manioc	Coffee	Cocoa
OURO PRETO						
Cultivated Area						
Up to 2 ha.	34.7	22.3	57.8	76.5	20.3	21.9
2 to 3 ha.	28.9	25.6	19.4	17.3	50.6	40.6
3 to 5 ha.	23.1	31.2	13.4	2.5	20.8	21.9
5 to 10 ha.	11.6	14.5	7.8	3.7	7.0	7.8
10 ha. and over	1.6	6.3	1.7	—	1.3	7.8
Total (N = 100 per cent)	242	269	232	81	182	64
Volume of Production						
Up to 15 sacks	19.8	8.8	73.6	55.6	44.4	34.2
16 to 30	29.5	18.3	17.0	11.1	16.7	29.0
31 to 50	23.0	16.0	5.5	22.2	14.3	21.0
51 to 100	18.9	30.9	2.8	11.1	15.1	7.9
100 and over	8.8	26.0	1.1	—	9.5	7.9
Total (N = 100 per cent)	217	261	182	9	126	38
GY-PARANÁ						
Cultivated Area						
Up to 2 ha.	40.1	20.0	47.8	85.4	20.1	50.4
2 to 3 ha.	28.7	28.5	25.0	8.7	16.8	8.3
3 to 5 ha.	19.0	27.8	18.5	4.8	20.1	4.2
5 to 10 ha.	11.0	19.6	7.3	1.0	29.1	20.2
10 ha. and over	1.3	4.1	1.3	—	13.9	16.8
Total (N = 100 per cent)	237	270	232	103	244	24
Volume of Production						
Up to 15 sacks	25.0	11.6	68.9	50.0	48.3	53.9
16 to 30	31.9	15.9	15.8	50.0	10.2	15.4
31 to 50	22.0	19.5	10.8	—	11.6	7.7
51 to 100	14.7	30.0	3.2	—	20.4	23.1
100 and over	6.5	23.1	1.4	—	9.5	—
Total (N = 100 per cent)	234	277	222	4	147	13

that arrives in the frontier areas searching for land. Their numbers grew in the second half of the 1970s, as land unassigned to plots became scarce. The Socio-Demographic Survey revealed a ratio of .3 *agregados* per settler in Ouro Preto and .2 in Gy-Paraná.

For the *agregados,* the search for a livelihood may have led them to accept unfair working conditions, but the settlers also have problems. The output extracted from a plot is generally not sufficient to provide for family needs. Our survey revealed, for instance, that in Gy-Paraná one-third of settler families had members who worked as wage workers during the 1979/80 agricultural year, often including the settlers themselves. The sale of family labour does not occur only upon arrival, but it is a resource to which the family continues to resort in bad times.[17]

Table 9 shows the amount of wage work done by settlers and *agregados* in Gy-Paraná in 1980. It was found that in the Gy-Paraná project, 23 per cent of the settlers worked away from the plot during the year prior to the 1980 survey, about two-thirds for four months or less. When this happened, the settler's own plot was left to the care of other family members, usually the eldest son. About the same percentage (26) of *agregado* household heads worked away from the settler's plot at some time in the year.

Problems of Settlers

In a previous research report,[18] we saw that settlers arrived with resources from their place of previous residence and with their family labour. Since the proportion of settlers with resources, either capital or equipment, was small the family labour force was the decisive factor for the exploitation of the plot and consequently for the possibility of survival. These facts indicate the importance of studying the maintenance of the labour force in the area, its health, and its food consumption.

First, in analyzing the characteristics of the households at the time of arrival, we observe that a significant proportion came as settlers. However, the proportion of settlers, and especially *agregados,* that went to work on someone else's plot while waiting for their own is also significant. Indeed, being an *agregado* is often part of the strategy while waiting to be selected to receive a plot from INCRA. Although it was longer in earlier years, the mean waiting time of those select few who had received plots was still 14 months in 1980. But waiting does not guarantee obtaining a plot, given that a considerable proportion of the current *agregados* (approximately 85 per cent) were *agregados* when they first arrived in Rondônia as well. The remainder of current *agregados* are former settlers, who fell into debt and had to sell their plot but wanted to remain in the area, and former wage-workers.

The heads of households in the survey were asked to state the main difficulty faced since being given the plot (see Table 10). Even though the proportion of Ouro Preto settlers who indicated that illness was the main difficulty since their arrival declined (cf. subsection on health and housing below), the rate is still significant at 11 per cent. The main difficulty, cited by 32 per cent of the settlers, was the lack of or precarious state of roads. In Gy-Paraná

Table 9

GY-PARANA PROJECT: PERCENTAGE DISTRIBUTION OF SETTLERS AND *AGREGADOS* BY TIME ENGAGED IN WAGE WORK IN THE PREVIOUS YEAR, 1980

Time in Wage-Work	Settlers	*Agregados*
Less than 1 month	8.0	—
1 - 4 months	54.7	38.9
4 - 8 months	17.3	27.8
8 - 12 months	14.7	11.1
Did not know how to estimate	5.3	22.2
Total (N = 100 per cent)	75	18

Source: Pinto (1981).

Table 10

MAIN DIFFICULTIES FACED SINCE LIVING ON THE PLOT, BY PROJECT (PERCENTAGES)

Settlers									
Project	**Lack of Roads**	**Illness**	**Transpor-tation**	**All Three**	**Other**	**None**	**Does not Apply**	**No Answer**	**Total**
Ouro Preto	32.2	11.4	1.3	12.8	23.8	12.8	2.4	3.4	100.00 (298)
Gy-Paraná	25.2	7.0	8.2	6.7	23.7	19.8	3.3	6.1	100.00 (329)

Agregados								
Project	**Lack of Plots**	**Lack of Work**	**Illness**	**Transpor-tation**	**Other**	**None**	**Does Not Apply**	**Total**
Ouro Preto	27.6	—	7.1	3.1	19.4	38.8	4.1	100.00 (98)
Gy-Paraná	32.8	3.0	4.5	3.0	14.9	31.3	10.5	100.00 (67)

also, the main difficulty cited was the lack of roads. It is intriguing that significant percentages of *agregados* (much higher than those of the better-off settlers) said they had not encountered any difficulties. Such a response may reflect fear that the authorities would learn of their response and cause them to lose their chances to obtain a plot, or fear of being kicked off the plot they were living on if the settler were to know their response. In any case, it reflects the conditions of insecurity and dependence endured by the *agregado* rather than their lack of difficulties.

The large majority of settlers and *agregados,* when asked to compare their current and their previous situation, answered by stating that they are better off after their move to Rondônia. The percentages were 86 and 89 for the settlers in Ouro Preto and Gy-Paraná and 66 and 79, respectively, for the *agregados.* Only small percentages answered that their situation had worsened, and only in the case of the Ouro Preto *agregados* did this reach as high as 10 per cent. The perception of life having improved is higher among settlers than *agregados,* as would be expected given their ownership of land. The percentage of settlers with a final title to the land is slightly higher in Ouro Preto (84%) than in Gy-Paraná (78%), but this small difference only shows that the age of the project has little to do with the legalization of plot titles.

It is worth mentioning that the ownership of a definitive land title means the possibility of access to rural credit and the potential to sell the plot in the future. Judging from talks with technicians and settlers in Ouro Preto, the sale of plots is frequent despite its illegality. In Gy-Paraná, over half the actual settlers said they had bought their plots from other settlers.

Health and Housing Conditions

In a previous analysis,[19] we showed that the majority of settlers consisted of former small landowners, share-croppers and rural workers expelled from areas where the minifundia spread or where a rapid process of modernization took place.[20] Those coming to the colonization projects had few monetary or other resources, most bringing a few household items and the necessary food for their initial maintenance (manioc flour, rice, and beans). As noted, the physical infrastructure as well as mechanisms for assistance to the small producer, though planned for colonization programmes, were either non-existent or insufficient to cover settlers' basic needs. Thus the possibility for productive occupation of the plot and consequent permanence in the area depended on the intense utilization of the settler's and his family's labour, making their health of decisive importance. A disease in the settler's family might mean not only the impossibility of subsisting from the plot's produce but also the need to sell the plot to pay the costs of doctor fees and medicine.

Indeed, it is a common belief in the area that the abandonment and/or sale of the plots by their first owners is often due to sickness. Weakened by their prior condition of being dispossessed workers and having to walk long distances to reach the project, the settlers sometimes had their last energies consumed in the work of clearing the forest and opening small roads, or were felled

Table 11

PERCENTAGE DISTRIBUTION OF SETTLERS AND *AGREGADOS* BY PROJECT ACCORDING TO THE EXTENT TO WHICH ILLNESS LED TO AN INTERRUPTION OF NORMAL ACTIVITY AND TO THE TYPE OF CARE RECEIVED, 1980

Item	Settlers		Agregados	
	Ouro Preto	Gy-Paraná	Ouro Preto	Gy-Paraná
Illness interrupted work				
Yes	67.8	62.2	58.7	56.3
No	14.2	24.9	14.3	25.0
No answer	17.1	12.9	27.0	18.8
Type of care				
Medical doctor	55.2	49.2	47.6	46.9
Pharmacy	15.3	18.3	15.9	28.1
Other	3.0	1.3	—	—
No one*	12.3	25.0	14.3	12.6
No answer	14.3	6.3	22.2	12.6
Total (N = 100 per cent)	205	241	63	32

* Refers to the sick who answered that they had not been treated by anyone. —ED.

by the malaria and hepatitis so frequent in the region. Then the plot, increased in value by the settler's work in clearing it, was sold to cover health costs.

Analyzing work interruptions in 1980 among settlers and *agregados* who became sick in the month before the survey, provides an idea of the health conditions of the population in the area (see Table 11). We note that a significant proportion of settlers and *agregados* had to interrupt their work at least once for health reasons in the first half of 1980. The frequency with which this occurred is similar in the two projects and is about 65 per cent in the case of settlers and 57 per cent in the case of *agregados*. The smaller figure for *agregados* does not mean they are healthier but only that they, though sick, could not stop working as they depend on the landowners for their survival.

Given their poverty and isolation, it is striking that half of those who were ill consulted medical doctors, though many were not seen by anybody qualified (especially if the "no answers" are included). In Gy-Paraná, note that nearly 30 per cent of the sick *agregados* consulted pharmacies. This may be a function of the age of the project, which has fewer health services and poorer transportation. Given that the network of health services is almost completely private, urban, and far from the plots, the high usage of doctors is an indicator of the time and resources that the settlers must expend for health services.

As for the type of illness, malaria and influenza were reported to be the most common. The first has as symptoms seizures and high fever, body aches, and the impossibility of working for periods that vary from one to three months. It is important to mention that a large majority of the settlers, even without knowing the name of the disease, indicated feeling weakness, exhaustion, and lack of energy.

Aside from being subjected to the diseases of the region, the settlers have precarious living conditions and deficient food habits as well. The vast majority of workers have wooden houses, made from material obtained in the clearing of land. In Ouro Preto 53 per cent of the settlers and 51 per cent of the *agregados* have brick or wooden frame houses,[21] while 17 per cent of the settlers and 28 per cent of the *agregados* have unfinished wooden (log), mud or other crude houses. In Gy-Paraná the situation is worse, with 42 per cent of the settlers and 57 per cent of the *agregados* having unfinished wooden houses. Generally these are small houses, having one or two rooms where all family members sleep and where the food is stored. The houses have cracks and nothing to prevent the entry of mosquitos which transmit malaria. The type of material used in the houses of settlers, compared to *agregados* in the two projects, is an indicator of the social stratification in the area. The proportion of *agregados* living in unfinished wooden houses or in mud houses that are more open to the elements and less sturdy, is higher.

The system of water provision in the two projects is inadequate, as illustrated in Table 12. The vast majority of settlers and *agregados* have no piped water. In Ouro Preto, 87 per cent of the settlers and 88 per cent of the *agregados* get water from a well or nearby river. In Gy-Paraná the percentages are even larger, 91 for settlers and 93 for *agregados*. All water is untreated and hence not potable, implying major difficulties for house cleanliness and hygienic care of family members. Moreover, the journey of the women to obtain the water is often considerable, and in many houses the proximity of the well or river to chicken fields increases the chances of contamination.

The best indicator of the precarious and unhealthy state of household living conditions may be the absence of sanitary facilities or facilities for human waste disposal (see Table 13). Most dwellings have no structured sanitary facility. Garbage is thrown out close to the house, and human waste was often observed near the house. Only 28 per cent of the Ouro Preto and 21 per cent of the Gy-Paraná settlers have even a rudimentary cesspool. We observe that in both projects the proportions of *agregados* with a cesspool are still smaller.

The settler's food habits also have serious deficiencies. Even though data collection difficulties made it impossible to determine malnutrition levels or the amount of food ingested, we observed that the settlers' diets were very restricted, the basic foods being rice, beans, corn, and manioc flour produced by the settler. Meat is seldom consumed and depends on the luck of the hunt or on whether the settler raises poultry or pigs. Vegetables and fruits, even though inherent in the food habits of the settlers coming from the South, are practically nonexistent. Only papayas and bananas are abundant in the region, the first as native plants and the second planted to provide shade for the cocoa plants. Milk, cheese, and other dairy products are rare. We found several families who, as

Table 12

PERCENTAGE DISTRIBUTION OF SETTLERS AND *AGREGADOS* BY MATERIAL USED IN HOUSE CONSTRUCTION, TYPE OF WATER PROVISION, AND TYPE OF SEWAGE DISPOSAL FACILITY, 1980

Items	Settlers		Agregados	
	Ouro Preto	Gy-Paraná	Ouro Preto	Gy-Paraná
House construction				
Brick	10.74	4.25	3.96	1.47
Wooden frame	58.39	40.12	51.49	29.41
Adobe	7.38	9.73	12.87	11.77
Log cabin	17.11	42.25	27.72	57.35
Other	6.04	1.52	1.98	—
No answer	0.34	2.13	1.98	—
Type of water provision and source				
With pipes	10.40	3.95	5.94	1.47
Well or river	9.06	3.95	4.95	1.47
Other	1.34	—	0.99	—
Without pipes	89.60	95.74	93.07	97.06
Well or river	85.58	90.88	88.12	92.65
Other	3.02	4.86	4.95	4.41
No answer	—	0.31	0.99	1.47
Total (N = 100 per cent)	298	329	101	68

soon as they obtained extra money, would buy powdered milk and fruit from the Center-South to give to their children. While the usual diet of settlers is similar to that of Northeastern Brazil, it is inferior to that of neighbouring states to the North where fish is common, and to the south where fruits, vegetables and meat are common.

DEMOGRAPHIC EFFECTS

Morbidity and Mortality

Gathering information on specific illnesses or diseases in the family from household surveys is known to be difficult. Several factors have a bearing: the difficulty of relating a symptom to a disease; the varying levels of seriousness of the disease before people recognize its existence; the use of different regional names for the same disease; and the usual absence of any medical diagnosis.

Table 13

HOUSEHOLD FACILITIES FOR ELIMINATING WASTE, SETTLERS AND *AGREGADOS*, BY PROJECT

Project	Covered Cesspool	Open Cesspool	Other	Nothing	No Answer	Total
Ouro Preto						
Settlers	5.4	22.8	1.7	69.1	1.0	100.0 (298)
Agregados	1.0	15.8	—	80.2	3.0	100.0 (329)
Gy-Paraná						
Settlers	1.5	20.7	1.0	76.9	—	100.0 (101)
Agregados	1.5	5.9	—	92.7	—	100.0 (68)

Given the nature of the population, all these factors were present in our survey, and to them we add that the interviews were conducted during the dry months when the frequency of malaria is lower.

As shown in Table 14, the illness distribution is more characteristic of a poor population than of one beset with high levels of tropical disease. The number of persons considered sick during the month prior to the survey was approximately ten per cent of the total in each project. The high frequency of the category "other diseases" indicates the difficulty of specifying a symptom and of relating symptoms to specific illnesses. Influenza appears in both projects as the most frequent illness, followed by malaria, which is reported to be twice as frequent in Ouro Preto as in Gy-Paraná. Indeed, the frequency of malaria is a matter of great concern for the health authorities: despite the large malaria eradication programme in the Amazon and the excellent work of SUCAM (Superintendency for Malaria Control) in Rondônia, the activity of clearing the forest together with the climatic characteristics of the area pose high malaria risks. Indeed, Rondônia's percentages of the reported cases of malaria in the entire Amazon region *rose* from 10.8 per cent in 1971 to 36.2 per cent in 1980.[23]

About half the households interviewed contained someone who had a serious illness in the previous month, though only about ten per cent of the total population was seriously sick (see Table 11 above). However, malaria, together with conditions of chronic malnutrition, poor food habits, and poverty, slowly exhausts the worker's resistance, increasing his susceptibility to other diseases.

Table 14

REPORTED ILLNESSES OF HOUSEHOLD MEMBERS DURING THE MONTH PRIOR TO THE SURVEY, BY PROJECT

Type of Illness	Ouro Preto	Gy-Paraná
Malaria	11.1	6.5
Hepatitis	2.7	1.0
Anemia	2.7	2.0
Flu	21.0	23.9
Tuberculosis	1.1	1.0
Delivery	1.0	1.5
Accident	3.2	4.0
Fever	4.7	3.9
Hemorrhage	1.0	1.5
Nervous system	2.1	2.0
Heart disease	0.5	0.4
Other disease	44.7	47.8
Do not know	4.2	4.5
Total	100.0 (190)	100.0 (201)

Source: Lima, J.T. Fiuza, *O Papel da SUCAM na Prevencao e Controle das Doencas no Contexto das Migracoes Humanas,* MS/SUCAM/1981; and Gonçalves (1981).

Of the persons sick during the month prior to the survey, the percentage who were heads of households (approximately 23 per cent) is similar in the two projects. Out of the remainder, 42 per cent were wives in Ouro Preto and 50 per cent children in Gy-Paraná. Also in both projects, 70 per cent of those declared to be sick had to interrupt their work or other normal activities which has potentially serious implications for their survival on the plot.

Given the size of the sample, it was not possible to make meaningful, direct estimates of mortality in the projects. Serious deficiencies in the coverage and quality of vital registration data also prevent its use as an alternative source of data. We thus searched for another indicator and examined the incidence of deaths in the family after they moved to Rondônia. With this measure, apparent differences between the two projects appeared large. In Ouro Preto, a death occurred in 27 per cent of the families, while in Gy-Paraná this happened in only 14 per cent. This finding should not, however, lead us to the conclusion that living conditions are worse in Ouro Preto than in Gy-Paraná. From the analysis of the migration tables, it is clear that the mean length of residence

of Ouro Preto settlers is longer, so they have greater exposure to the risk of dying.[24]

An analysis of data from the Socio-Demographic Survey also finds that about half of the deaths that households reported occurring in the 12 months prior to the interview were to infants, i.e., to children less than 12 months old (44 per cent in Gy-Paraná and 50 per cent in Ouro Preto).

A separate investigation of mortality in Rondônia, based on the 1970 census, yielded estimates of life expectation at birth as follows:[25] for males, 46.6; for females, 50.7. Separate estimates for rural areas wre 45.9 and 50.2, respectively, illustrating that mortality levels in the region are very high, far higher than in other regions of the country or in Brazil as a whole.

Fertility

It is well established that Brazilian fertility fell rapidly during the 1970-80 decade. This occurred in every state except Rondônia. In Table 15 we present fertility estimates derived through the Brass P/F ratio method (indirect estimation), using data from the 1970 and 1980 population censuses.

Fertility levels in Rondônia as a whole did not change significantly. This could perhaps have been predicted because there was massive in-migration in the decade, with many migrants characterized by high fertility. Indeed, the settlement programmes selected large existing families among potential candidates to become settlers.

We estimated fertility rates in the two projects from the IC-Cards from listings of family members and their ages. Children younger than one year in 1975 were selected as the numerator and the women's age in 1975 served as the denominator to establish the 1975 age-specific fertility rates. In the survey, we obtained pregnancy histories until 1980, and this information was used to calculate fertility rates for 1979-1980. Both sets of rates are presented in Table 16.

According to these rates, fertility declined during the five-year period by one child per woman.[26] The IC-Cards represented the fertility at time of selection, and given that the size of the family was one of the criteria for a settler's selection, a high fertility rate was expected. Thus the result was unexpected given the characteristics of the population and the usual tendency towards high fertility in such a land-plentiful agricultural setting where infant deaths were also high (see high morbidity levels presented above). Table 17 presents the distribution of average numbers of children ever born and children lost. It is clear from Tables 15 and 17 that fertility is still quite high and that many women start becoming pregnant at early ages (15-19). The total fertility rate for the two projects is 6.84, or about the same as that of rural Rondônia as a whole, according to the 1980 census. Fertility peaks at 20-24 but doesn't drop much until age 35-39, which is characteristic of the fertility pattern found in a population not using contraception.

It is clear from Table 17 that child losses occurred at a high rate, which probably reflects the poor health and nutrition of women. Risks were higher for younger (15-19) and older (45 and over) women where the losses represented more than half of the average number of children born alive in Ouro Preto

Table 15

AGE-SPECIFIC AND TOTAL FERTILTY RATES FOR URBAN AND RURAL RONDONIA, 1970 AND 1980

	1970		1980	
Age Group	**Urban**	**Rural**	**Urban**	**Rural**
15-19	61	108	116	144
20-24	210	270	297	346
25-29	252	333	279	332
30-34	252	225	202	242
35-39	196	226	130	190
40-44	109	162	84	80
45-49	54	56	11	29
TFR	5.670	6.900	5.590	6.820

Sources: Berquo (1977) for 1970, and IBGE, *Censo Demográfico 1980, Rondônia* for 1980. Age-specific rates are per 1000.

Table 16

FERTILITY RATES COMPUTED FROM IC-CARDS AND THE SOCIO-DEMOGRAPHIC SURVEY BY PROJECT AND AGE GROUP OF MOTHER

	1975	1979-1980	
	IC-Cards	Socio-Demographic Survey	
Age Group	**Ouro Preto and Gy-Paraná**	**Ouro Preto**	**Gy-Paraná**
15-19	137	158	400
20-24	444	306	396
25-29	356	300	146
30-34	345	295	192
35-39	192	182	121
40-44	102	100	128
45-49	14	28	26
TFR	7.95	6.84	7.04

Source: IC-Card and Rondônia Socio-Demographic Survey

Table 17

AVERAGE NUMBER OF CHILDREN EVER BORN AND AVERAGE NUMBER OF CHILD LOSSES BY PROJECT BY AGE GROUPS OF THE MOTHER 1980

Age Groups	Average Number of Children Ever Born		Average Number of Child Deaths	
	Ouro Preto	Gy-Paraná	Ouro Preto	Gy-Paraná
15 - 19	0.63	1.20	0.58	0.67
20 - 24	2.33	2.15	0.83	0.71
25 - 29	3.38	3.35	1.03	0.82
30 - 34	4.41	4.62	1.16	0.90
35 - 39	5.62	5.41	1.54	0.91
40 - 44	6.55	6.89	1.83	1.19
45 - 49	6.70	7.09	2.63	1.24
50 - 54	6.86	7.29	3.07	2.56

Source: Rondônia Socio-Demographic Survey

Table 18

PREFERENCES TO STAY OR MOVE OUT OF RONDONIA, SETTLERS AND *AGREGADOS,* BY PROJECT (PERCENTAGES)

	Settlers		*Agregados*	
Preferences	**Ouro Preto**	**Gy-Paraná**	**Ouro Preto**	**Gy-Paraná**
To stay	90.0	91.1	82.0	76.1
To move	10.0	8.9	18.0	23.9
Total	100.0	100.0	100.0	100.0
	(297)	(325)	(100)	(69)

and a little less in Gy-Paraná. In fact this finding might be at the core of the fertility difference between the projects.[27] The losses encompassed both infant deaths and fetal losses, as it was obvious from the interviews that the women could not conclusively differentiate between the two. The women in the projects conclude their reproductive lives with an average of close to ten pregnancies, high by any standards and an important influence on their health status.

In spite of poor indicators of mortality, it is clear that natural growth levels are high, mainly as a consequence of high fertility. Such high fertility may arise partly from the family labour model type of settlement, but it is also clear that the replacement phenomenon (linked to high infant mortality) also plays a role.

Migration Intentions and Conclusions

An important question is whether people intended to move on to another place of residence. We observe in Table 18 that almost all settlers, and even the great majority of *agregados,* declared an intention to stay in Rondônia. When we asked settlers their reasons for staying, their answers were vague, suggesting a lack of clear positive evaluations of the settlement area. Specifically, only ten per cent of the settlers in each project referred to having sufficient production on the plot as a reason for staying. The intention to stay was also confirmed by settlers declaring that they would not sell their plot, even if legally permitted. Only one settler out of six stated he would sell his plot.

In concluding the discussion of migration, we present findings derived from information on the characteristics of the settlement process in Rondônia and on the settlers' profile. First, even taking into account the differences between the two projects, it is possible to identify the flow of migrants to Rondônia as the most recent flow in the country, particularly intense in the second half of the 1970s. The especially rapid growth of *agregados* is a visible indicator of a

saturation in INCRA's capacity to provide settlements for in-migrants. The characterization of migrants as "permanent migrants" in this process of intense occupation of frontier areas such as Rondônia is qualified, on the one hand, by the dynamics of the settlement process and the clearing and preparation of the soil, and, on the other, by the migration history of the settlers. When we looked at the settler's previous experience, we saw a tendency for them to clear a frontier, provide the soil conditions for cropping, and then be expelled from the land by large-scale capitalist agri-business. The migratory flow to Rondônia is basically made up of small landowners, tenants, and rural workers expelled from other recent agricultural frontiers, such as the south of Mato Grosso (especially in the Jaciára Municipality, which accounts for 28 per cent of the migrants, and Caceres and Dourados, accounting for another 28 per cent), the West of Paraná, and other areas in the Center-South of Brazil. Out-migration from these areas is partly a consequence of the implementation of crops oriented towards export, aided by mechanization, and partly by the eradication of coffee in some areas of Minas Gerais and Espirito Santo and its replacement by animal-raising in Mato Grosso. Apparently, this process is accelerating over time, since the period of residence of migrants in the more recent frontiers has become shorter than in the older frontiers.

But there were, as noted, almost unanimous statements from the project settlers about how their living conditions had improved when compared to their previous residence. Settlers intended to stay in the area and not sell their plot even if permitted. Nevertheless, important difficulties were found in the colonization projects. INCRA's capacity to open roads, demark plots, and provide assistance to settlers was overwhelmed by the intensity of the demand for land so that more recently INCRA has limited its action to that of legitimizing *de facto* situations. This has generated new conflicts that add to the violence among settlers, *agregados,* and squatters, and to the deficiencies in credit, transport, commercialization, and storage.

FINAL REMARKS

In this chapter we analyzed the socioeconomic and demographic conditions of settlers, *agregados,* and their families in two government-supported, directed colonization projects in the Rondônia area of western Brazil. Most of the information came from a Socio-Demographic Survey conducted in June-July, 1980. The richness of the information collected is only partially depicted here (see Appendix), and the analyses reported herein are preliminary and will be expanded in future work.

We believe that the inhabitants of the colonization projects are typical examples of Brazilian rural workers—landless, illiterate and under-nourished. Minas Gerais and the Northeast appeared as the most frequent places of origin in the projects studied, though the migratory pathways are usually not direct, but through Paraná and Mato Grosso as places of previous residence. The length of residence in these states is, on average, shorter than for migrants coming from other states of previous residence, suggesting that the transformation in the system of agricultural production in Paraná and Mato Grosso have acted

as push factors. With respect to previous agricultural experience, more than half of the settlers were formerly small landowners or tenants, while more than half of the *agregados* were rural workers or tenants.

Health problems are stated as major difficulties faced in Rondônia, but as settlers stay longer in the projects, they see lack of roads as a larger problem. However, these difficulties are not enough to discourage the settlers, as 85 per cent (and 70 per cent of *agregados)* believe their current situation to be better than in their previous residence. One factor may be singled out as accounting for this—for the first time in their lives they (84 per cent of settlers) have a legal title to land.

The reproductive potential of the population in the two projects is quite high, with a young age structure and very high levels of fertility. Strangely, despite the lack of health facilities and failure to seek medical attention for all but the most catastrophic illnesses, it is customary for a pregnant woman in Rondônia to go all the way to a hospital in a city to bear her child.

With no resources other than the land and the family labour force and with practically no infrastructure, the productive occupation of the plot is a huge challenge, extremely demanding physically and very hard on settlers' health. For those who cannot succeed, the alternative is the (illegal) sale of the plot and out-migration. To those who remain, we must give our admiration for having endured the rugged living conditions of the Amazon frontier.

NOTES

Chapter Six

1. The research was supported by a Rockefeller Foundation grant and also received substantial institutional support from the Instituto Brasileiro de Geografía e Estatística (IBGE) and the National Institute of Colonization on Land Reform (INCRA). All translations from Portuguese to English are those of the author.
2. Merrick, Thomas and D. Graham, *Population and Economic Development in Brazil: 1800 to the Present* (Baltimore: Johns Hopkins University Press, 1979).
3. Graham, Richard, *Britain and the Onset of Modernization in Brazil 1850-1914,* (New York: Cambridge University Press, 1972).
4. Redwood, John, *Internal Migration, Urbanization and Frontier Region Development in Brazil Since 1940.* M.A. Thesis, Urban and City Planning, Mimeo, (Berkeley, CA: University of California at Berkeley, 1970).
5. Nicholls, William H., "The Agricultural Frontier in Modern Brazilian History: The State of Paraná, 1920-1965." *Revista Brasileira de Economia,* v. 24, n. 4, Oct-Dec, 1979.
6. Redwood, John, *Internal Migration.*
7. Chaloult, Norma Beatriz, "Settlement Along the Trans-Amazon Highway: Planning and Reality." Presented at a Conference on the Development of Amazonia in Seven Countries, Cambridge, England, 1979.
8. Wood, Charles and Marianne Schmink, "Blaming the Victim: Small Farmer Production in an Amazon Colonization Project." Interciencia Association Symposia on Nutritional Agriculture: Strategies for Latin America, February, 1978, mimeo.
9. Ibid.
10. Ibid.
11. Pacheco, Lenita M.T. "Estrátegia de Sobrevivência da Pequena Producão na Fronteira Agrícola: Projectos de Colonização Ouro Preto e Gy-Paraná." Paper presented at the Terceiro Encontro Nacional de Estudos Populacionais, Vitória.

12. There are several issues involved in land distribution. On the one hand, it is often said in the area that land in Rondônia is "sold up to the fifth floor." While this is a joke, the truth is that there are many disputes over land. On the other hand, there is Government land which has been gradually put under the Colonization scheme. A problem has been the speed with which it was given away without accurate demarcation. There is also a large area under private property; land under squatters, Indian reserves and natural reserves and land occupied by non-reserve Indians. While the Government has increased by half the originally planned number of settlers in the state (from 20,000 to 30,000), it has not given plots to all of them.
13. This included a road barrier or checkpoint on BR-364 to attempt to restrict in-migration. The barrier was a police control unit placed at the southern end of Rondônia on the frontier with Mato Grosso, the usual entrance to Rondônia. Police would check documents of migrants and allow in only those with the proper I.D. and proof of having received a plot or a contract as a wage worker. However, this control unit did not work at night, so as soon as this became known, people who did not have the required documentation would enter at night.
14. *Agregados* are migrants who arrived in the area and were unable to obtain a legal title or unoccupied land. They work as sharecroppers or agricultural labourers for the settlers.
15. For details, see Appendix.
16. This also was the chronological direction recommended in Bilsborrow, et al. (1982), and in contrast to World Fertility Survey Procedure. Note that *only* the wife of the head was asked this information, excluding the other women in the household of childbearing age. Also, no family planning information was sought, there being no clinics or convenient places to seek family planning. Information on absentee children refers to their *current* situation not the situation at the time they left the plot. Note that given the (older) age of many household heads, they may have absent children who had left their household before it moved to Rondônia; therefore, there was a question on whether they had ever lived on the plot. ED.
17. Pacheco, Lenita M.T. "Estrátegia de Sobrevivência."
18. Henriques, Maria Helena F.T., "The Colonization Experience in Brazil: A Case Study." Paper submitted to International Labour Office. Forthcoming in book being edited by A. Oberai.
19. Henriques, Maria Helena F.T., L.M. Pacheco and J.L. Petrucelli, "Research Report No. 1: Basic Concepts and Preliminary Description", Mimeo, 1980.
20. Becker, Olga, et al., *Areas de Atracão e Evasao.* Serie de Estudos de Pesquisas, No. 4 (Rio de Janeiro: IBGE, 1979).
21. Brick and finished wooden frame houses may be considered good quality structures, while the others are of low, even temporary quality, usually with no floors. ED.
22. Lima, J.T. Fiuza, *O Papel de SUCAM na Prevencao e Controle das Doencas no Contexto das Migraciones Humanas.* MS/SUCAM/1981; and Goncalves, Maria das Gracas, *Reproducâo da Força de Trabalho em uma Area de Fronteira Agricola: Rondônia*. M.A. Thesis, Dept. of Social Sciences, Brasilia University, Brasilia, 1981.
23. This may be a result of (a) better detection of cases in Rondônia as the area developed, (b) increased population in Rondônia relative to other parts of the Amazon, and (c) increased population density and opportunities for contagion in Rondônia. ED.
24. Analyses of the proportions of children surviving by age group of mother and project appear later in this report. ED.
25. Carvalho, Jose Alberto, "Fecundidade e Mortalidade na Brazil: 1960-1970" (Belo Horizonte, Brazil: CEDEPLAR, 1978).
26. In the absence of significant family planning, such a decline seems improbable, and may be due more to the changing composition of the population: in-migration from *other* areas of Brazil where fertility was declining. The unusual values for age groups 15-19 and 25-29 in Gy-Paraná are associated with very small sample sizes. ED.
27. The slightly lower levels of fertility in Ouro Preto may reflect slightly better access to urban areas and to health and educational facilities. ED.

Additional References

Berquo, Eliza, "Fecundidade Rural-Urbana dos Estados Brasileiros, 1970." *Revista Brasileira de Pesquisa,* v. 38, n 151, 1977, pp 286, 291.

Bilsborrow, R., A. Adlakha, A.R. Cross, D. Chao, and M. Nizamuddin, *Analyzing the Determinants of Fertility: A Suggested Approach for Data Collection.* POBLAB Manual Series No. 9 (Chapel Hill, NC: International Program of Laboratories for Population Statistics, 1982).

Contini, Elisio. *A Colonizaçâo na Transamazônica. Um Enfoque Analítico do Plano Governmental, sens Resultados e Problemas.* M.A. Thesis. Fundacao Getulio Vargas, Rio de Janeiro, 1976.

INCRA. *Metodología para Programaçâo Operacional des Projectos de Asentamento de Agricultores* (Brasilia: 1971).

Oliveira, Francisco de and Henri-Philippe Reichstal, "Mudanças na Divisao Inter-Regional do Trabalho no Brasil." *Estudos CEBRAP,* No. 4, April-May-June, 1973.

APPENDIX

QUESTIONNAIRE CONTENT

The questionnaire contained the following information:

Plot identification: name of project, location, distance to the BR-364 highway.

Settler identification: whether settler or *agregado,* sex, age, marital status, and educational level.

Characteristics of household: type of construction, water facilities, sewage facilities, improvements added to the plot.

Family composition: for each family member: relationship to head, sex, age, marital status, educational level, working status (whether working in house or field or not), and income in previous month.

Absentee children: current age, sex, marital status, educational level, place of actual residence, whether main activity working, and sector, contribution to family's income (amount of remittances), and whether ever lived on plot and reasons for leaving.

Fertility history: date of birth, sex, and survival status of all live births.

Morbidity information: diseases in the household during the month prior to the interview; whether interrupted normal activity; whether seen by qualified person, and expenditures on health in previous month.

Mortality information: deaths in the household after the move to Rondônia (age, date, cause).

Migration history: municipality and state of birth, previous residence, and next to previous residence; duration at previous residence and reasons for migration to Rondônia; type of work in previous residence; intentions to remain or leave Rondônia, and reasons.

Feelings of permanence: whether would sell the plot and why; whether believe children would remain on the plot and why.

Comparisons with previous situation: whether owned land, was tenant farmer, wage employee in previous residence; dates of arrival in Rondônia and at the plot; initial form of occupation of the plot (authorized or not, etc.) and its size; main difficulties at time of arrival, after receiving the plot, and at present; general evaluation of situation in comparison with previous one.

Production: for each crop, whether interplanted, whether sharecropped; volume of production and use for family consumption, animal consumption, and sale (how much); amount lost and reason for loss; animal raising; area under pasture; planned area and crops for next agricultural year.

Wood extraction: type of wood, volume, channels of commercialization, and price per cubic meter.

Food consumption: items and amounts; whether produced on the plot or bought (at what cost), or obtained through exchange.

Relationships with labour market: family members working outside plot; whether permanent or temporary, where, annual days of work and wage received; number of *agregados;* permanent and temporary workers hired in the previous week and in the previous six months to work the plot: production share of *agregado* family.

Technical assistance: whether received, how much, and from which institution (bank or private lender).

Co-operative affiliation: whether a member, opinion on its functioning; if not a member, why; whether a member in place of previous residence.

Labour unions: knowledge of any rural labour union in the area; if yes, whether a member; if not, why not; whether participation in any labour union in place of previous residence.

Consumer durables: items at time of arrival and at time of survey; estimated monetary value of each item at time of arrival and at present.

Agricultural inputs (fertilizer, insecticide, etc.): whether used and expenditures on each.

METHODOLOGICAL ISSUES IN ASSESSING THE POPULATION IMPACT OF RURAL DEVELOPMENT PROJECTS

Richard E. Bilsborrow
and
Pamela DeLargy

Rural development projects are planned, funded, and undertaken by various actors: national, regional, or local governments; multi-, bi-lateral, and private assistance agencies; and private companies. Project goals might be, for example, to increase agricultural production for domestic consumption or export, to improve the quality of life in rural areas, or to settle and develop previously unoccupied lands for social, economic, or political reasons. Many rural projects are designed to meet a combination of goals and may have explicit or implicit demographic goals as well—slowing rural-urban migration, for instance. Except for the most obvious population factors, such as the necessity of migration for the settlement of new lands, however, project planners have given little thought to the demographic aspects and impacts of their projects. Even where planners are cognizant that changes in the production and consumption patterns of rural people and changes in the level and type of social services in an area might affect mobility, fertility, and mortality in ways that make purely economic evaluations incomplete for judging the success of projects, there are still no clear guidelines. For nearly a decade now it has been a chic topic—the population impact of development projects—yet there have been no "ideal" studies; that is, those where a researcher could clearly discern before and after project patterns. Indeed, there have been few actual field studies of any kind that have been written up and presented for others to learn from. In this volume we have presented five pilot field studies that provide us with some guidelines towards how to design and carry out better population impact studies in the future.

We wish to emphasize that neither in this chapter nor in this book do we attempt to develop a universally "correct" methodological approach for appraising the demographic effects of development projects. A wide range of textbooks and specialized studies exist on project appraisal including general methodological works[1] and studies providing guidelines on the measurement and assessment of the socioeconomic effects of rural development projects.[2] The United Nations Manual IX discusses methods specific to the analysis of the effects of family planning programmes,[3] and broader aspects of policy analysis for rural development are considered in Johnston and Clark.[4] In another vein,

the evaluation field itself has recently undergone some evaluation, it being clear that evaluation criteria vary not only by topic but by country circumstance, and involve subjective as well as objective elements.[5]

The purpose of this chapter is thus the more modest one of summarizing and methodologically assessing the five case studies in order to point the direction toward improved approaches in the future. We begin with a very brief summary of the project purposes and findings before comparing and discussing the projects in terms of their theoretical approach, data collection procedures, analytical methods, and policy implications.

SUMMARY AND COMPARISON OF STUDY FINDINGS

The five studies were undertaken, beginning in 1979 or 1980, to assess the demographic effects of rural development projects. Two studies assessed the effects of rural electrification, two the effects of colonization/settlement schemes, and one the effects of an irrigation scheme. Each study is based upon primary data collection at the household and/or community level. The data were collected at least partly to assess one or more demographic effects, though several had other purposes as well. Data for a control group were also collected in each study, though the control groups are rather limited in three of the five studies.

Topics analyzed included effects on in- and out-migration, fertility, knowledge and use of family planning methods, mortality and morbidity, and a host of "intervening" variables such as household production, women's employment, problems of adaptation in the new area, school attendance, health problems, and plans for staying in the area or not. All the studies were carried out on shoe-string budgets, which seriously restricted the scope of data collection and especially the analysis. Further analysis continues based upon several of the data sets (e.g., by Herrin and Henriques), so this is another reason that the summary in the paragraphs below should be viewed as provisional.

The two electrification projects (in the Philippines and Colombia) found a wide range of positive economic changes made possible by the availability of electricity, including increased output and increased purchases of electricity-using consumer durables. But from that point the two studies diverge, the former looking only at fertility and the latter only at migration. By comparing rates of out-migration from two villages over time, the author of the Colombia study concluded that village electrification resulted in a decline in the rate of out-migration. The Colombia study used aggregate (aggregating across households) time-series analysis in contrast to the Philippines study which was based on micro, cross-section analysis. The Philippines investigation is, indeed, the only study among the five to investigate the separate effects of household electrification and community electrification on household demographic behaviour. Household fertility was found to be negatively influenced by electrification of the *area* but not by electrification of the particular households. While this can be interpreted as showing area-level effects to be more important for fertility behaviour than individual-level effects—which would have important policy implications (see below)—this is still an anomalous finding requiring further examination. Moreover, *both* individual and community use of electricity were

found to be positively associated with a woman's use of modern family planning methods, as expected, but were not related to whether she desired more children, which was unexpected and appears inconsistent with increasing consumption and use of electricity-using consumer durables.

The one irrigation project investigated, the pilot project of Pramote and colleagues in Thailand, found that substantial positive socioeconomic and demographic changes occurred as a result of irrigation. Economic changes included use of multiple cropping, more regular employment, and higher levels of production. While the resulting increase in land values was thought to be responsible for lack of in-migration to the irrigated villages, the other hypothesized demographic effects did seem to occur, viz., improved health, increases in the perceived cost of children, and, most clearly, declines in fertility and increases in family planning use. However, rural inequality *across* villages increased because of the increase in land values in the irrigated villages (Bunnag et al., observed this as well in another irrigated area of Thailand[6]). This is the sort of side effect of development which is of concern to policy makers and which should be considered in the project planning process.

The two colonization or land settlement projects (in Nigeria and Brazil) are similar in that both were instituted by the federal government with the intention of attracting people to land-plentiful areas from people-plentiful areas. Both projects achieved their basic goal: they attracted large numbers of families from areas of high population density and therefore contributed to the desired redistribution of population. Moreover, those migrants who actually became legal settlers, or were receiving wages for their labour on plantations in the case of Nigeria, intended to remain. In Brazil, however, far more would-be settlers came to the projects than could be provided for, considering the land allocation process and the level of infrastructure development. This is not unusual; for example, in a project assessing the impact of a large irrigation-cum-infrastructure project in Thailand, 39 per cent more "invaders" were attracted than was planned for.[7] In the Brazilian case, the heavy influx of migrants seriously diminished the possibilities for improvement in living conditions of migrants. Consequently, though the project may have relieved some population pressures elsewhere, the outcome in terms of quality of life of the settlers cannot be considered as successful as expected. This provides a valuable lesson in the importance of careful planning of projects from the beginning.

There were also other disappointments with the projects in terms of demographic effects. In Nigeria, even though schools and health clinics (with family planning methods available) were much more accessible to the plantation than the non-plantation control populations, levels of fertility and family planning use have remained about the same in both to date. Differences in the school attendance of girls and in attitudes toward family planning do suggest some prospects for future differences to evolve, but so far they have been small and therefore appear to be of long gestation. In Brazil, fertility levels also remain very high for wives of settlers; planned future tabulations comparing fertility levels of settlers (with secure titles to land) and *agregados* or sharecroppers (with no title) should help illuminate the extent to which the availability of land is pro-natalist, as widely hypothesized. Another wrinkle in the Brazilian data is

that the majority of migrants did not come directly to the Rondônia settlements from the densely populated, poverty-stricken Northeast, as had been hoped. Finally, health conditions (and presumedly mortality) for the settlement-area populations are very poor and would appear to be generally worse than in the areas of origin. Land ownership conflicts continue to be widespread and land distribution very unequal. Martine[8] in fact notes that land distribution is no better in Rondônia than in other states of Brazil despite the presence of the large government colonization projects, but this is not uncommon for such projects it seems. For example, Kloos[9] gives an interesting account of the land rights problems which persist in the Awash plain of Ethiopia years after a government irrigation-colonization programme was instituted.

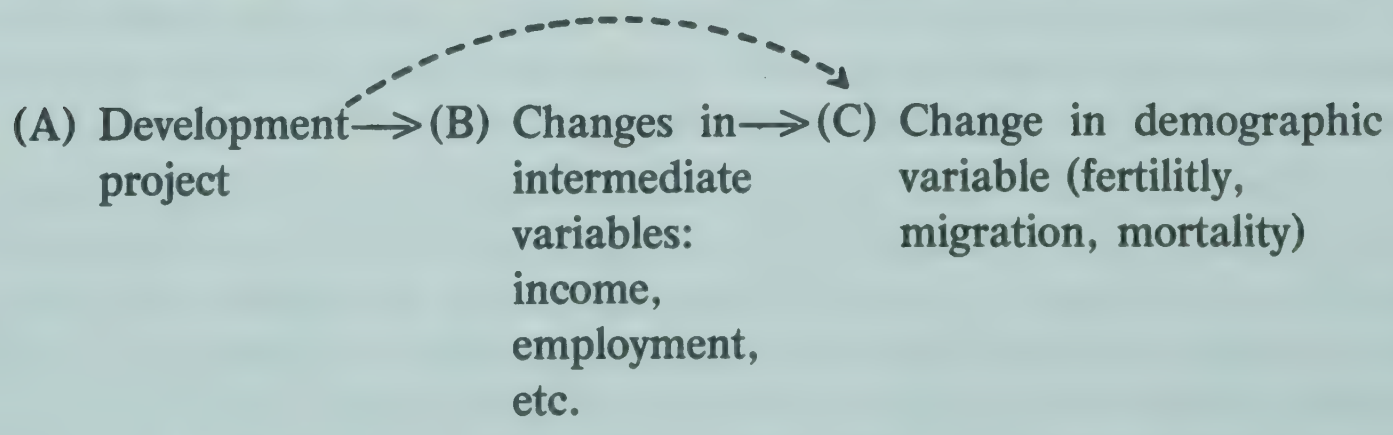
RESEARCH DESIGN: PROBLEMS ENCOUNTERED AND LESSONS LEARNED

In this section we briefly compare the research methods used in the five case studies, identifying where problems were encountered and where improvements, within the scope of the limited financial resources available to the authors, could have been made. This is not intended as a critique of the studies but rather to, at least implicitly, offer some methodological guidelines for future work using micro-data to assess the demographic effects of rural development projects. Of course, hindsight always has the advantage over foresight.

The discussion will be brief and related as specifically as possible to the five case studies, though some broader experience will be drawn upon as well. We will first discuss theoretical aspects briefly, followed by data collection and data analysis in more detail. Since the most important concerns and problem areas relate to the theoretical conceptualization and associated survey design issues, we will devote the most attention to those.

Theoretical and Modelling Considerations

The general theoretical approach may be indicated very simply as follows (see also the figures in Chapters 2, 4, and 5 above):



That is, the development projects had been undertaken, for the most part, for the purpose of improving the living conditions of the population in the country rather than altering demographic processes. This does not mean the projects were not expected to have demographic effects, but rather that these effects were considered incidental and of secondary importance. This is the usual situation with economic development projects, though in some projects it may be

possible to incorporate features in the original project design to maximize favourable, anticipated demographic impacts or to alter unfavourable effects. In a 1979 workshop, World Bank officials considered this possibility but expressed reservations because of the technical complexities of the process.[10]

The types of projects discussed in this book are essentially *economic* projects intended to have economic effects on population, employment, and consumption. Their demographic effects are indirect, as seen in the path diagram from A to C; thus there are no *direct* effects of rural electrification or irrigation on C. The dotted line designates effects which exist for some other types of development projects. For example, the expansion or improvement of family planning programmes should have a direct effect on fertility, provided the demand for family planning methods is greater than the existing supply. Similarly, the expansion of health facilities should have some direct effects on morbidity and mortality. In both instances, any economic effects would be in the direction from C back to B (that is, the path diagram would be A----> C----> B). Indeed, some officials at the World Bank workshop noted that because the demographic effects of economic development projects are indirect, the Bank should only assess the demographic effects of projects of the A----> C type (i.e., a family planning programme) rather than those of the A----> B----> C type.

Of course, better ways of measuring A----> C would also be extremely useful, and the present book *does* include projects of the A----> C type if one considers the effects of the projects on *migration.* The projects described in Chapters 5 and 6, on Nigeria and Brazil, are colonization projects which are explicitly intended to alter population distribution by altering migration patterns. They essentially do this, however, by altering the physical environment and infrastructure in an area so as to improve production and therefore income-earning opportunities. But the path is still A----> C----> B: the people have to be attracted and actually move to the area before production levels or other forms of behaviour can change. After they arrive, production increases. In Nigeria, government plantations were created to attract wage workers and their families. Substantial social infrastructure was also provided. Not only were plantation workers and their families attracted, but many others moved to the plantation areas to provide food and services from the fringes, as well as temporary labour when needed on the plantations. Of course, some of the social infrastructure provided (for example, schools and health clinics) may have directly influenced fertility and mortality of the in-migrants after they arrived at the plantations (but only to the extent that they had more access to these facilities than in their earlier place of residence). In Brazil, much less infrastructure was provided but the hunger for land was such that vast numbers of families came. But in addition to the migration effects, these two studies attempted to appraise the effects of the colonization project on the fertility or mortality of migrant families, analyses again of the type A(project)----> C(in-migration)----> B(social and economic changes)----> C(fertility changes in migrants). The Nigeria study examined fertility effects: the length of time involved in the A----> C----> B----> C chain is undoubtedly one factor contributing to the difficulty in detecting any significant effects on fertility to date. But there is much more to consider in appraising the demographic effects of development projects.

Consider fertility. Ideally, the extensive literature on the determinants of fertility should be drawn upon to develop theoretical and modelling approaches for investigating the role that any particular develoment project has in influencing fertility. Several theoretical approaches exist, ranging from economic theories (including but not limited to the "new home economics") to socio-psychological approaches and "supply"-focused models emphasizing the role of family planning. It is increasingly clear that approaches which integrate the major elements from all three are superior *a priori,*[11] but the practical problems of combining all three into an estimable model make simplifications necessary and add to the appeal of economic models, appropriately augmented.[12] However, existing econometric tests of economic models as applied to developing countries have been seriously flawed. This lack of a fully acceptable and testable fertility theory is a major barrier to designing a model to assess the effects of a development project on fertility. Moreover, to the extent the major project effects (for example, from electrification and irrigation) are economic, the lack of significant "pure" income effects on fertility[13] means that, in general, for the project to significantly affect fertility, it must induce changes in *other* things associated with modernization and economic expansion—things more directly associated with fertility. Possible examples are increased employment of women and changes in tastes for and access to consumer goods (partly via higher family incomes).

In fact, none of the projects evaluates the project effects using a specific theoretical model—for example, an explicit model of fertility or migration to assess the project effects on fertility or migration, respectively. This leads to a host of problems, as will be discussed below. It also is associated with rather brief or imprecise statements of *specific* hypotheses, though the Asian and Colombia studies do lay out and examine several of interest.

An important family of micro-theoretical models sees demographic variables such as fertility and migration as interrelated with a number of other household decisions, greatly complicating inferences about causality. Where models which do not embody this complexity are utilized (as in this volume), their limitations should be recognized.

To further complicate the problem of assessment, the economic development project is often part of a *programme* of changes in infrastructure, or in the whole socioeconomic environment, as noted at the beginning of this subsection. Other components of the programme may include education and health policies, which usually have more direct demographic effects. But then any observed changes in fertility or mortality cannot be attributed to the development project but rather must be attributed to the other components of the programme, perhaps in combination with the development project. In the case of all the projects investigated (with the *possible* exception of Colombia where no information is provided about other contemporaneous changes in the communities), the development project was accompanied by other concomitant changes in infrastructure which greatly confounded the estimation of the A---->C effects, since A was instituted *pari passu* with other changes. And since all of these changes may alter villagers' lives, they should all be taken into consideration and evaluated simultaneously.

To illustrate, considerable infrastructure was provided as part of the plantation settlement programme in Nigeria, so that the "programme effects" observed refer to the effects of that particular *package* of infrastructure changes on population in the region. In Thailand, adjoining the new irrigation canal was a new road connecting the villages to important small cities in the region and, in addition, national family planning and rural health programmes were being expanded in the country and may have been differentially administered in the villages selected. In the Philippines, a range of infrastructure improvements, including expanded family planning services, were provided along with electrification. Even in Brazil, there was some, albeit very limited, provision of infrastructure. But at minimum, what we are evaluating in Brazil are the effects of the INCRA colonization programme in the two particular project areas *combined with* those of the new highway providing access to the Rondônia region.

The tendency of governments to provide *packages* of development inputs in an area makes project impact research extremely difficult. And at this point, neither the theoretical framework nor the statistical estimation methodology is fully developed. The investigators reporting their work in this volume, limited by methods as well as time and financial constraints, had to examine rather simple notions of the demographic impacts of their projects. That the results are not convincing is to be expected. Nevertheless, there appear to be ways in which the methods of data collection can be improved upon. The next sections discuss some of the possibilities.

Data Collection

1. *Survey and sample design*

The survey design must be intimately tied to the theoretical framework and serve that framework. In principle, a careful assessment of the effects of a development project requires that: (a) the project should be implemented in a large number of randomly selected areas, (b) there should be no other concurrent development projects in the areas, and (c) both baseline and subsequent instruments should be used to collect detailed information on the households affected to compare them "before" and "after." We are here referring to the appropriate *experimental design* of the survey.[14] If (a) is true, areas not receiving the project may be compared with those receiving it, and serve as *natural control areas.* If (a) is true, (b) is not necessarily a problem, *if* the other projects are both randomly distributed and have smaller effects on the criterion variable(s) than the project under investigation. But in practice (a) is never true, for reasons of budgetary restrictions or political realities (persuasive politicians usually get more projects implemented in their areas). And (c) has not been possible in the past, though with foresight this need not continue to be the case. Note that if both (a) and (b) are true, cross-area or cross-sectional comparisons of households in areas with and without the project can be made to investigate the effects of the project, and only one single-round survey is needed, not two as in (c).

The general approach of the case studies in this volume was indeed to conduct a survey in areas affected by the development project and in areas not affected. The basic form of analysis is thus *cross-sectional,* comparing "treatment" (in biostatistical terminology) and control populations. Thus we are interested in whether $X_t(P) > X_t(C)$ for output or "effect" variable X (for example, income, reduction in fertility, etc.), where P = population in project area, C = population in control (non-project) area, and the subscript t = time (t = time of interview).

The utility of cross-sectional analysis for evaluating the impact of a project is based on the assumption that changes across households at a point in time reflect changes over time within households. Some feel cross-sectional differences reflect rather long-run or "equilibrium" changes. But we have seen that sampling limitations—which are almost inevitable and likely to be serious—are such as to raise very serious questions about the comparability of areas. A way out of this dilemma is to attempt to assess the effect of the project on a *specific* population over time. That is, in the algebraic terminology used earlier, one wants to compare $X_t(P)$ with $X_0(P)$, where the population in the project area received the development project between time o and time t.[15] A single *retrospective* household survey can, in principle, collect information from households on their situations at both time o and time t. In the case of one key dependent variable, fertility, we know this is possible and has been done in many surveys in many countries through the World Fertility Survey programme and by means of fertility and pregnancy histories. One can also relate other, perhaps secondary, events in a woman's (or man's) life to the dates of childbirth and marriage to obtain better information about them. This was an important factor in the partial labour force history approach developed by POBLAB as an integral component of household surveys aimed at collecting data for the investigation of the determinants of fertility.[16] Other surveys have collected marriage, education, migration, and labour force history data. An approach has been developed to attempt to collect all these simultaneously through so-called "life-histories."

If we look at Table 1, comparing data collection approaches in the five projects,[17] we see that four of the five involved household surveys, and two had community surveys. All five projects collected data in some sense for control populations, though this was very limited for the two in Latin America. In Brazil, where field survey conditions were extraordinarily difficult, data were not collected for a strict control population. But some limited comparisons are possible across the two settlement project areas since they were of different vintage and had different levels of socioeconomic infrastructure: one site serves as an indirect control for the other. The same situation exists in Colombia, where one town expanded secondary education and the other electrification; each was an indirect control for the other.[18] In the case of Colombia, the possibility of studying the effects of expanded education as well as electrification developed fortuitously and not according to the original survey design which aimed at studying only electrification.

Nevertheless, the use of only one control population (and only two in Thailand) enormously weakens the validity of drawing conclusions about project effects from cross-sectional comparisons in three of the five projects. In-

deed, to the credit of all three sets of authors, their analysis plan attempted to get around this by comparing the populations *over time* (point (c) above, discussed below). Still, these authors offer little explanation either of why they only chose the number of areas they used, or recognition of the implications for drawing conclusions from such a limited data set. We only know that the two Colombian towns are generally similar in socioeconomic conditions and distance from Bogotá and that the two projects in Brazil were chosen *a priori* to reflect "good" and "poor" project site situations. Criteria for selecting the five villages in Thailand are not described.

The two projects with more adequate control populations are those of the Philippines and Nigeria. The numbers in Table 1 are, however, misleading. In Nigeria, the number of project areas was only eight, and the 200 control villages were selected from an area 100-200 miles away (presumably to ensure no contamination effects from the project, but in fact they were areas of out-migration to the plantation projects). The areas were said to be selected "with care" so as to achieve "prior equivalence" to the plantation areas, and were all located along several main roads to simplify interviewer access. No further information is available on how they were selected. A similar judgmental selection procedure was used in the Philippines, with the treatment and control areas then statistically compared: "Detailed community data . . . were obtained . . . to test the assumption of homogeneity of the eastern and western banagays" (Ch.2). While the formal statistical test used implies homogeneity, there were differences identified between the two areas: the West is closer to the provincial capital (Cagayan de Oro City) and to health facilities and had three times as many rural extension visits, while levels of education and female employment were higher in the (non-electrified) East. It cannot be determined *a priori* what the implications of these differences are.

The selection of *project* sites in Nigeria was also a judgment sample. The largest and smallest of 19 government plantation projects in Cross Rivers State were selected with certainty, then six others were chosen to ensure representation of all three types of plantations (oil palm, cocoa, and rubber). The selection of small numbers of areas using judgment versus probability sampling is not to be faulted. Kish himself stated this in his text,[19] which has been supported in empirical work.[20] While there is little choice in small-budget projects such as those of the Consortium, such small numbers of areas or communities must increase the circumspection with which conclusions are accepted.

We now consider the procedures used for selecting *households* within areas, which is not relevant to either Thailand (a community survey) or Colombia (where all the households in the two towns were covered). To begin with, in Table 1 it is worth noting that household sample sizes varied from 200 (Colombia) to 4,036 (Nigeria). The latter was an especially impressive accomplishment with a small budget. In Nigeria, as well as in all the other projects, the sample sizes in the project and "control" populations were roughly similar. Unfortunately, in published research based on survey data, it is rare for authors to describe their sample in sufficient detail (if at all, beyond mere sample size!) to permit the reader to appraise its effect on the results in terms of possible biases and therefore acceptability. After some urging from the editors (see Addendum to

Table 1

METHODOLOGICAL COMPARISON OF PROJECTS: DATA COLLECTION

	Philippines	**Colombia**	**Thailand**	**Nigeria**	**Brazil**
Type of project	Electrification	Electrification School Extension	Irrigation	Plantation Settlement	Colonization Settlement
Type of Data Collection	Household and Community Survey	Household Survey	Community Survey	Household Survey	Household Survey
Number of Sample Points (Communities or Areas)	20	2	5	208[a]	2
Sample Size (households)	800	200	508	4036	800
Use of Control Group	Yes	Yes, indirect	Yes	Yes	Yes, indirect

Use of Pretest	Yes	Yes	No	Yes	Yes
Duration of Training of Interviewers	3 days	n.g.	1 month	n.g.	2 weeks
Ratio of Interviewers to Field Supervisors	n.g.	n.g.	n.a.	10:1	6:1
Interviewer Characteristics	Residents	Residents	Non-residents, students	Mostly residents	Non-residents
Interviewee	Head and wife	Head	Selected residents	Head and wife	Head and wife

[a]Eight plantations and 200 control villages.
n.a. = not applicable; n.g. = not given.

this chapter), most authors provided additional information, but less than was sought. In general, it is evident that the household samples selected in Brazil and the Philippines qualify as *probability samples* but that the Nigeria samples do not.[21] It is worth indicating what we mean by this, not to cavil about the Nigeria project but to illustrate extremely common pitfalls in the field. First, 55 per cent of the plantation sample in Nigeria was from a single (the largest) plantation, and different *proportions* of households were selected from each plantation: thus the probability of selection of a household head differed according to which plantation he lived on, violating the desired equal probability of selection. Second, for the non-plantation sample, in each of the 200 areas sampled, households were selected systematically after a random start. This is common and generally acceptable, but they were selected only along the main road. Thus a dwelling which was not on that road had no chance of being selected. Third, if a dwelling was not occupied by a head and spouse, the one next door was taken, violating the equal probability of selection rule. Fourth, within the household the procedure was to interview the "first household head" encountered (and his wife) and "sometimes" another head. What times? We don't mean to dwell on this, but such deviations from scientific sampling are far more common than the rather careful ones followed in the Philippines and Brazil. In research reporting, if there are special reasons for using ad hoc procedures, then it is important to discuss the reasons.

The collection of *detailed* data in a life history is likely to yield poor data for many reasons: it is very long and complex (interviewers and respondents make mistakes); responses suffer from memory error the farther back in time the questioning covers; and there are problems of coding and processing such a large volume of data multiply. These problems fortunately can be reduced by covering in detail not the whole life history but only the last five or ten years (or better, the time since just before the development project was instituted, i.e., $t + 1$ years ago). It is even simpler to reduce the intermediate period information and seek detailed data about the situation of the household at only two or three points in time, for example, at $t + 1$ (and possibly $t - 1$) years ago and at present. For analytical purposes, one would compare, for example, health conditions or the *pace* of childbearing (birth intervals), before the project and after.

But this doesn't solve all the basic problems either. Changes in such factors as income levels, female employment, or the pace of childbearing in the project area after the project is instituted may be no greater than those in other areas of the region or country. So it is important to compare $[X_t(P)-X_0(P)]$ and $[X_t(C)-X_0(C)]$. In sum, one needs either a careful and high quality *retrospective* survey in *both* project and non-project areas, *or* one needs two separate and comparable household surveys in *both* project and control areas, the first being the baseline survey.

At this point it is appropriate to comment on the unique quasi-anthropological approach to data collection followed in the Thai study. Anthropology students at Mahidol University were given one-month of special training and then were sent to the five selected villages (one to each village) to live for three months. They observed the behaviour of villagers, conducted a cen-

sus, and interviewed a cross-section of (judgmentally-selected) younger and older men and women about their lives in the past (i.e., before irrigation, in irrigated villages) and at present. Since the selection of a small number of study areas can always be questioned regarding its representativity, the project designers increased the number of communities to be studied and reduced the time period within each community, in comparison with the usual anthropological approach of living for a year or more in a single community. This is a most intriguing way of attempting to combine the intensive anthropological method with a more extensive sociological approach, though it seems unlikely "to avoid the individual's interpretation bias." Indeed, it is too easy to selectively collect data to verify *a priori* expectations when the data are not collected on a random selection of households in a large number of scientifically selected communities.

The Thai study looks both at changes across (irrigated and non-irrigated) communities and changes within them over time. For all its possible selectivity and interpretation biases, it is unique in this sense. It is also unique among the five in being a *community*-level analysis, not an analysis across households, although Herrin also collected data for communities. Indeed, Herrin's project collected quite rich community data (see Appendix to Ch. 2), which could be used for comparative community-level (cross-community) analysis. But this was not done for the chapter herein, nor subsequently to date.

The crucial importance of collecting *both* community- and household-level data to quantitatively investigate the determinants of either migration or fertility (or mortality, for that matter) has been discussed elsewhere[22] and was the theme for the June 1983 WFS Seminar in London.[23] Individual and household decisions are made in the context of a community whose facilities and norms influence behaviour. Ignoring this context will usually lead to exaggerated estimates of household-level effects and, moreover, ignores potentially important policy variables. This is becoming increasingly recognized.[24]

2. *Questionnaire design*

The issue of questionnaire design and content could be treated in great detail, but rather than present large numbers of specific suggestions for each of the questionnaires, we instead highlight several major positive and negative aspects of each.

In the case of the Thai project, explicit questionnaire design considerations do not arise as no questionnaire was used to collect community information. Rather, student-observers were asked to record impressions on several broad topics in their own way. The only formal structure was in the short household census enumeration used to get basic demographic characteristics (age, sex, marital status) for all village residents. We feel strongly, however, that a form of structured community questionnaire, somewhere in detail/complexity between the short WFS or POPLAB versions[25] and the longer ILO version[26] would have been very useful. This would have ensured that more complete and comparable information, even if still impressionistic, would have been collected for all villages. The student observers need not have administered it formally to village residents (though doing so with village officials and knowledgeable informants would have

been valuable), but could have used it as a reference to formulate their own questions (i.e., in open-ended form) to seek information. This would have helped the Thai data collection procedure to produce a much richer and less subjective set of information on the sample communities.

Regarding community questionnaires, let us continue with that used in the sample *barangays* (communities) in the Philippines.[27] Appendix 2 to Chapter 2 indicates the content of the Philippines questionnaire, which is indeed comprehensive. The only general quibble is that Blocks 6-8 may be seeking more information than we know how to usefully utilize. It is also disappointing that the rich community-level data have not been used in community-level analysis: n = 20 communities is adequate for real comparisons and offers statistical possibilities which go well beyond the simple East-West comparisons presented to date.

Turning to the content of the individual questionnaires, the Nigerian instrument has serious weaknesses in the schedules for both the man and woman, though the broad topic coverage is good. To begin with, fertility information is not collected from a fertility history (even partial) nor linked to infant mortality nor breastfeeding. Indeed, there is *no* information from the woman's questionnaire on her total live births, those alive at the time of interview, *or* the date of the last birth (only age of "first child" still alive and age at marriage)! The male head, however, is asked his number of wives (total); number of children "you have now" (ever born or surviving?—not clear); the total number currently dead by sex (but again, not by wife); and the numbers of living children "below age 5," "6-12," and "above 12." (What happened to age 5?) Such imprecise questions, in an area where there is vast experience and commonly accepted questionnaire design, render suspect the analysis of fertility based on these data. In defense of the author, it must be recognized that there were considerable problems in developing questions on family planning and fertility desires that made sense to the respondents. These difficulties were much more pervasive than in the other countries. The problems were carefully confronted in a pretest and solutions skillfully adopted. As the author notes, "appropriate translation of terms in survey research [to tribal language] is crucial." Indeed, Uyanga's discussion of the cultural difficulties in interpreting concepts and questions to Nigerian men and women on these topics may be among the most interesting reading in this monograph. And the result was a good set of questions on a difficult topic (family planning), which contrasts with those on a more straightforward topic (fertility and child mortality).

The Colombia questionnaire is impressive in its topic coverage but very cumbersome in its format, which must have complicated both the work of interviewers in the field and data processing, with probable effects on data quality. Because of the author's exclusive focus on migration, no fertility information was collected, but he did gather detailed information on migration (including return migrants), production by crop, animal husbandry, time worked and wages, costs of production, and ownership of consumer durables, particularly those requiring electricity. However, no information was collected at the household level on the cost (if any) of obtaining an electric connection, the date of connection, or the subsequent usage level and cost payments. There is also

no information on actual school attendance (vs. enrollment) of children, which is important given the author's analytical focus. Finally, the questionnaire detail and format on production, costs, and incomes is overly complicated, which may have contributed to its low quality, as reported by the author. A simpler, but still fairly comprehensive, questionnaire design for collecting that information is now available in Bilsborrow et al.[28] and other places.

There is far less to say about the household questionnaires used in the other two surveys (Brazil and the Philippines). Regarding fertility and mortality data, both use careful pregnancy histories, with the woman as the respondent (as appropriate), and collect all dates, and pregnancy outcomes, including the survival status of child and date of death if dead. However, there is one important area omitted in the Brazil schedule: there are no data on breastfeeding, use of contraception or other birth control methods (before or after arriving at the project), or desired family size. Detailed information is collected on migration, including the current location, economic activity, and remittances received from children who have left the family unit since the family came to Rondônia, and on migration expectations for children still in the home. The latter is used to assess the long-run inter-generational retentive prospects for the settlement project areas, which is clearly important for policy planning. While some attitudinal information was collected on settlers' perceptions of their situation in their previous residence before coming to Rondônia, no quantitative economic or demographic information was obtained on their actual situation at that time, such as would be needed for analysis of the $X_t(P)-X_0(P)$ type, using our earlier terminology.[29] Finally, a considerable amount of useful health and morbidity information was collected, focusing on illnesses of household members in the 30 days prior to the interview. However, the data collected on *cause* of death seem of little value here (or in Thailand) because of the small sample size and the unreliability of the information.

The Philippines project used the best-designed and most complete questionnaire. But then it was at least the third full-scale survey in the same region by the authors and was funded by multiple sources and so had to dance to different tunes (ergo its comprehensiveness). Certainly some of the detail was not needed for the appraisal of the demographic effects of rural electrification. On the other hand, very useful information about *when* consumer durables were purchased (which can be related to the date of electricity connection), their cost, and the costs of the electricity connection and electric bill per month were collected. But, as in Colombia, none of this information, dealing with the *direct* effects of electrification on household consumption, has been analyzed.

Questionnaire length is, of course, intimately tied to the duration of interview. While very long interviews can lead to interviewer and interviewee fatigue (or reduced co-operation) and lower quality data, this has rarely been found to be a problem in developing countries, particularly in rural areas.[30] While exact data were not provided by the field investigators, orders of magnitude for the *total* duration of interview(s) per household would be as follows (excluding "getting acquainted" time): one-half hour in Nigeria; one to two hours in Colombia and Brazil; and two to three hours in the Philippines. But it should be born in mind that the time in Brazil refers to the combined duration of inter-

views with the husband and wife, and that in the Philippines it is the sum of the durations of interviews from several separate visits to the household, with part of the information collected on each visit. Such separate visits made it possible to collect more detailed information without risking data quality. Repeated visits in the Philippines were economically feasible because of the use of local (resident) interviewers—which is not likely to be feasible in most situations.

In concluding this section, it should be noted that somewhat different information will always need to be collected relating to the specific type of development project (or package of projects). For example, the information required for appraising the effects of a colonization project, (for example details on land tenure and use) is rather marginal for appraising an electrification project, while data on household usage of electricity is of little use for appraising a colonization project. The information desired also depends on the demographic impact one is interested in—for example, migration, fertility, or mortality/health—though we see no general reason for restricting the topic coverage to one or the other since the marginal cost of a few more questions is trivial once the rest of the survey is in place. Broad general outlines of surveys for use in appraising the demographic effects of development projects are therefore possible. The best general questionnaire guidelines we can offer at this time are those of Herrin, Bilsborrow, et al.[31] on fertility (as augmented by questions on the pre-project situation) and the ILO volume on migration.[32]

3. *Fieldwork*

In this section we briefly consider all aspects of the field data collection process, from interviewer training to pre-testing the questionnaire(s), choosing interviewers and interviewees, organization and supervision of fieldwork, and the actual fieldwork. Let us begin with the choice of interviewers and interviewer training.

In Table 1 above, we see that in three of the four projects, interviewers were residents or inhabitants of the communities where they conducted the household interview; the one exception is Brazil where it would have been extraordinarily difficult to locate people with the necessary experience and skills in the Rondônia area, particularly on the project sites. That the interviewers in Brazil were urban students from Rio may have, in fact, contributed to their high dropout rate in the field, discussed below. In general, the other authors' use of resident interviewers was probably appropriate since it tends to contribute to higher rapport and lack of status/ethnic differences and jealousies between interviewer and interviewee. But it may require greater time for training than would be the case if more educated and/or experienced non-resident interviewers were hired. Nevertheless, we suspect that in some cases the use of authority figures, such as military personnel (in Colombia) or plantation foremen (in Nigeria) may have distorted responses.

Training is a general problem. Indeed, no information at all is available here on training for two countries despite our requests to the authors. In Brazil two weeks of training was found rather minimal, so having training for only three days in the Philippines for such a complex and lengthy household ques-

tionnaire(s) appears far too little (see Table 1). While project staff from Cagayan de Oro visited the field to supervise periodically, surely more training would have reduced the awkward learning-by-doing process which must have existed in the field. In Thailand the training was of a different, non-comparable nature, as described earlier.

In any case, the duration of interviewer training must be considered generally inadequate, through not atypical. Substantial experience now exists in training interviewers (and supervisors) through survey programmes such as those of the WFS, ILO, POPLAB, and government statistical offices around the world. An evolving rule of thumb is that it takes two weeks' training for a short questionnaire (for example, POPLAB) and three to four weeks for a longer one. Also there should be more candidates than posts to allow for attrition during the course, and provision for a few trained alternates to be available to be called upon if interviewers drop out during the actual field work. Careful discussions of technical concepts, role playing, tape recording, sample interviews in the field, and of interviewer-supervisor responsibilities need to be covered in the training.

The ratio of interviewers to supervisors is, alas, also not provided in two of the four applicable studies. The ratio in Nigeria appears much higher than normally recommended but, at least on the plantations, this may have been acceptable as houses are clustered and the interview schedule fairly short. But in the control areas, the 10:1 ratio would appear somewhat high. The ratio of 6:1 in Brazil appears adequate, given the logistical impossibility of sending a supervisor out with each interviewer when households are so dispersed. Under more normal conditions, a generally recommended ratio for administering detailed questionnaires is 3:1 or 4:1.

Pre-tests are very important in order to test the comprehensibility of the questions to respondents, the length of the questionnaire (i.e., duration of interview), the sequencing and ease of use for interviewers, and the acceptability of proxy respondents, as well as to develop codes to pre-code questions and to orient field workers to actual field conditions. All projects used pre-tests meaningfully, which led to improvements in their questionnaires. This was particularly crucial in Nigeria where many of the original questions made no sense to the respondents and needed to be altered. But with the new, complex questionnaires used in Brazil and Colombia, whether one pre-test was enough could be questioned. Pre-tests of the *community* questionnaire are also important, but are not reported as having been carried out in either the Philippines or Thailand. The lack of such pre-tests in the WFS has apparently contributed to the weakness or irrelevance of much WFS community-level information. As a positive example, Chayovan and Knodel[33] describe a process of carefully pretesting a community schedule three times for Thailand. Important improvements resulted-from each pre-test.[34] One rather suspects that multiple tests of complex household schedules would also be useful, though there has been an almost universal tendency not to pre-test adequately, to rush into the definitive field work as quickly as possible.[35]

In terms of the actual fieldwork, field conditions were described as being quite difficult in Thailand and especially Brazil. In the latter, the long hikes

to get to the settler's plot, the oppressive heat and humidity of the Amazon, and illnesses led to no less than half the interviewers leaving the project before the field work was finished. No particular information is available on the fieldwork in the Philippines or Colombia, but several peculiar features of the Nigeria project should be mentioned. In Nigeria, a procedure was adopted to substitute the "next household" after encountering no one at the sample dwelling with one callback. This is a common error cited as such in sampling textbooks, and prevents the sample from being a probability sample of households. In Nigeria non-sample errors also exist, with some contamination resulting from the husband and wife always being interviewed together. Finally, in polygamous households, the household head chose *which* wife (only one) he wanted to respond and in practice chose the eldest. In the plantation sample this introduces only minor biases in the reported distribution of women by age, children ever born, education, etc., because only 5.5 per cent of the males had more than one wife. But 20 per cent of the males in the non-plantation sample had more than one wife.

Finally, the sole focus of the Colombia study is on out-migration, resulting in two serious problems with the survey design. Information about out-migrants, even on their *reasons,* must be collected from proxy respondents remaining in the town, usually the household head. How reliable can this be? More important, and a problem which lurks through most migration surveys, is what is known about the incidence, timing, or reasons for out-migration of entire *households* which, by definition, are not available in an origin-area only survey? We will return to this point later.

Analysis of Data

1. *Data coding and data processing*

In several cases more extensive use of pre-tests could have led to more complete precoding of questions (reducing the "other" that needs to be coded *ex post*). But the authors provide no discussion of problems here, though coding some of the economic questions such as occupation or industry/sector must have been cumbersome.

Data processing, on the other hand, was a persistent problem, even in those developing country contexts where one would expect it to be among the least problematic, for example the premier universities in the Philippines, a wealthy Jesuit University in Colombia (with the largest university population research programme in the country), the large government statistical office in Brazil, one of the two major universities in Thailand (with a large population research programme), and a major state university in Nigeria. But problems in data processing occurred in all four sites where computer processing was involved. In Nigeria, because there was no computer facility at all at the University of Calabar, Uyanga had to go to a distant state to process the data.[36] In Brazil, the author worked at Instituto Brasileira de Geografiá e Estatística which has a large IBM computer, but it was often busy during working hours, and cumbersome, bureaucratic forms had to be completed and approved each time it was to be used. Some of the work was therefore done at the University of North Carolina,

as in the case of Colombia.[37] In the Philippines, the main problem was that the well-trained programmer who had initially worked on the data resigned from the university to take a private sector job (a pervasive problem for governments in developing countries as well). Several months passed before this programmer could be consulted to redo some data processing.

The difficulties and delays in data processing that these projects experienced are by no means unusual. The World Fertility Survey has reported problems in data processing to be the biggest problem experienced in the WFS programme. When establishing the research schedule, perhaps a useful rule of thumb would be to make the most careful possible estimates of the time required to carry out each aspect of data processing, from data entry and validation, machine range checks, sequencing checks, internal consistency checks, and subsequent data quality and consistency checks based on initial tabulations, to be able to compare distributions across major variables against outside sources (external consistency)—and then multiply by two! Unfortunately delays in data processing also contributed to budget shortfalls as well.

2. *Tabulations and statistical analysis*

Table 2 broadly illustrates some of the project differences in terms of demographic topics analyzed and methods used to date. The projects which examined fertility included all but Colombia, those covering family planning were all but Colombia and Brazil, those covering migration were all but the Philippines, while those covering mortality or morbidity were only Brazil and Thailand.

The standard first technique recommended in studies such as these, which have project impact and control areas, is to compile and tabulate data for project areas to compare with that for control areas. This was done in all projects, but given the sample sizes and procedures for selecting control areas, the meaningfulness of the differences between areas declines as one proceeds from the Philippines to Nigeria to Colombia or Thailand to Brazil. In Colombia and Brazil, in particular, the controls are only indirect, so comparisons over time become (and were treated as) more important. Where the numbers of project and control areas are so small, observed differences cannot be assumed to be representative of anything larger than the communities themselves. This is surely the case for the studies in Colombia, Thailand, and Brazil.

But the question arises, *which* macro tabulations should be made? Answer: those that measure the demographic (impact) variables of interest or other important intervening variables such as nuptiality (ignored in all analyses), use of family planning, female education and work, and perhaps mean consumption and per capita incomes. Specialized tabulations are also needed on variables directly related to the particular development project (for example, in the case of electrification, on the ownership, purchases, and use of electricity-using household or business durable goods). As an example, ter Wengel documents the far faster rate of purchase and accumulation of durable goods in El Peñon than in Villa Gomez after the former was electrified in 1976. Similar tabulations could have been presented for the Philippines and perhaps for Thailand. In the two

Table 2

METHODOLOGICAL COMPARISON OF PROJECTS: TABULATIONS AND ANALYSES PERFORMED

	Philippines	Colombia	Thailand	Nigeria	Brazil
Topics Analyzed in Report:					
Migration	No	Yes	Yes	Yes	Yes
Fertility	Yes	No	Yes	Yes	Yes
Family Planning	Yes	No	Yes	Yes	No
Desired Family Size	Yes	No	Yes	Yes	No
Mortality	No	No	Yes	No	Yes
Morbidity	No	No	No	No	Yes
Macro-Analytic Comparisons of Project and Control Areas:	Yes	Yes[a]	Yes	Yes	Yes[a]
Using Tabular Analysis	Yes	Yes	Yes	Yes	Yes
Using Regression Analysis	No	Yes	No	No	No
Micro-Analytic Comparisons of Persons/Households in Control and Non-Control Areas:	Yes	No	No	No	No
Using Tabular Analysis	No	—	—	—	—
Using Regression Analysis	Yes	—	—	—	—
Before/After Analysis	No	Yes, indirect	Yes	No	In process

[a]Indirect control group, the "other city" in Colombia, other project population in Brazil.
— Not relevant or not possible.

colonization projects, documenting such direct project effects would require obtaining information on the household situation prior to migration (for example, on fertility, household income) and comparing it with their present status. Tabulations comparing the settlers' status now and that in the previous place or residence would have thus been possible. In Brazil, tabulations show some (usually not major) differences between the two projects. Unfortunately, because of the questionnaire design, this is not possible except for fertility and very broad indicators of occupational-landholder status.

In Colombia, data were tabulated to show the general similarity in the two towns, although differences existed in the levels of school attendance (*sic,* enrollment) and changes in the acquisition of household electrical goods over time (before and after electrification). Tables on the latter topics are thus especially interesting. In the case of the Philippines, Tables 1 to 5 are a most useful and succinct way of comparing project and control communities on a topic-by-topic basis.[38] Comparisons are made with respect to distances away from the state capital, school facilities, and health care; main sector of production or crop grown; housing materials; educational attainment of men and women; and

marital status, fertility, and family planning use. These differences are described but not analyzed in the text.[39] Similarly, tabulations in the Nigeria project indicate similarities and differences in fertility and family planning between plantation and control areas. Finally, in Thailand the observational method is nonquantitive, but some tabulations are presented on net and gross migration by village, extent of remittances received, mean children born and surviving, and causes of death, between "treatment" and control areas. Thus macro-tabulations are an important first step in the analytical process, and the authors should have provided more of them and analyzed them. But the value of this information would have been far greater if pre-project retrospective data were also obtained from households (and preferably communities as well).

The last line of Table 2 refers to whether before (project) vs. after comparisons were made for the same population group. This was done in a nonquantitative way in Thailand. Indeed, a very useful project would have been extending the Thai approach to several dozen communities and doing quantitative community-level analysis, even if funds were not available for the large concommitant household survey which the authors had originally planned. In Colombia, several useful before-after tabulations have already been cited, and the Brazilian author intends to compare the pace of childbearing prior to and after arriving at each project in the future, at our suggestion.

Such basic tabular analysis is useful for forming general impressions, but is not sufficient for investigating relationships between variables where more than one may influence the criterion (for example, demographic) variable, which is always the case. For this, multivariate techniques are needed. But to date only two studies have used them (for example, multiple regression analysis)—ter Wengel, based on aggregate time series data for the two towns in Colombia, and Herrin, based on household-level data in the Philippines. The Colombia regression is of the form $M_i = b_o + b_1$ Village $+ b_2$ Friends/relatives, for $i = 1970 \ldots 1979/80$, where M_i indicates net out-migration and Village is a dummy variable. It is a novel approach, for which the author is to be congratulated, as it attempts to test whether the rate of out-migration *over time* changed after the project was instituted. Unfortunately, there are a host of potentially important variables which were not included (though the data were collected). The author's argument against including income because it "didn't work," perhaps because the data were weak, is not convincing. The measure of income is not discussed. There appear to be differences between the two communities in age distribution, education levels, and other factors which could have influenced migration over time. Finally, the regression results themselves are far weaker than the author implies, the key village variable being statistically significant in only two of the ten years (with only one having the correct sign).

A strictly individual-level analysis is a logical complement to the ter Wengel approach, and some investigators may subsequently be undertaking one, but the only other multivariate analysis carried out in the case studies herein is that of Herrin. And he carries the estimation model an important step beyond the usual household model, which is of the form $F_{ij} = a_o + \Sigma a_i X_{ij} + e_{ij}$, where F_{ij} is the ith woman's fertility in the jth community, X_{ij} are independent variables measured at the individual or household level, the a's are regression coefficients,

and e_{ij} are error terms. Herrin uses a "multi-level" model of the type $F_{ij} = a_0 + \Sigma a_i X_{ij} + b_j X_j$, where X_j refers to the level of the *community* variable in j and the b_j's are the community variable regression coefficients. In his Tables 6-10, Herrin finds household but not areal electricity important determinants of women's fertility, and both important determinants of use of modern family planning methods.

While in its present form Herrin's statistical work is the most sophisticated of the five case studies, it still only scratches the surface. A deeper scratch would begin by including (i.e., in the regression) other community variables as well, such as availability/location of schools and health clinics, and also testing interactions between individual/household and community variables. But this is only a deeper scratch. The area of multi-level analysis promises to experience some revolutionary developments in the near future.[40] But we caution that the most exciting techniques do not substitute for well-conceived research designs which lead to the collection of useful and reliable data in the first place.

Finally, it is worth noting that none of the five case study authors documented the *economic* effects of their project, though most collected the necessary data. These are important because they fall in the middle of the analytic scheme, i.e., B in A--> B--> C; and, to the extent there are important ongoing changes in the "intermediate" economic variables, B, there may be related changes in demographic behaviour, C, that can be expected to occur sometime in the future. In fact, despite the authors' explicit use of the general analytical scheme described above, they do not carefully discuss or document the economic effects of the project, limiting the scope for projecting significant future demographic effects via this path.

Inferring Policy Implications from the Results

Each of the authors attempted to draw policy implications from the findings. In some cases, the policy implications were clear and logically followed from the author's view of his/her results—for example, Colombia and Thailand. But as far as determining the population impacts of the projects, in both these cases (and Brazil), sample sizes and heterogeneity were rather limited for drawing strong conclusions, and the statistical results in Colombia were quite weak. In the other two cases, Nigeria and the Philippines, the wealth of data is such as to encourage one to draw more explicit policy conclusions, but analysis using only two-way tables (as in the former) is only a beginning and does not convince. Further analyses need to be carried out. Even in the Philippines, where the multivariate results suggest a significant effect of electrification in the community on (reducing) fertility, more extensive testing of community variables is desirable, as indicated above.

How does this relate to policy? Very intimately. Individual-level effects represent only passing, indirect evidence of policy effects. We must focus attention on community variables, which measure things quite close to actual policy variables—whether local policies or higher-level government policies transmitted at the local level. A person's education is not a policy variable, but the existence and location of a school (which indicates the convenience of obtaining

an education) is. This is true as well for other government facilities. Indeed, there may be a host of rather large structural changes in a community as a result of a large project—changes in production patterns, in land ownership, in the composition of the community population because of migration, in the roles of women, in desires for education or consumer goods—which would be desirable to document over time (as attempted in the Thailand project.)

In terms of *large* government development projects (such as a dam in the region, as in Thailand), the relevant policy variable is whether the village has irrigation water or not. There is thus a need for collecting areal- or community-level data if one is to proceed very far towards inferring policy implications, whatever the demographic criterion variable of interest. And since a development project often comes with additional infrastructure, information on the (other) types of infrastructure (including dates of installation and usage levels over time) is crucial. To the extent different combinations of projects and infrastructure are expanded at different times and rates in communities, efforts can be made to estimate their separate effects, if data are collected for enough communities.

The time frame is important to also bear in mind in impact analysis. The effects of colonization/settlement programmes on altering the environment and attracting migrants can be quite quick. Indeed, any development project which alters income-earning prospects can have significant effects on *migration* and therefore population distribution even in the short-run, because migrants respond to economic opportunities fairly quickly so there are few "gestation" lags. On the other hand, in the cases of fertility and mortality, improvements in economic opportunities often require considerable time to have effects,[41] perhaps a decade or more rather than the few years observed in most projects in this volume. Such lags should be carefully considered in designing surveys to collect information to assess the demographic impacts of development projects. If one wished to investigate fertility effects, for example, it would be desirable to have a significant number of years, for example ten, between a baseline survey and a later survey. In the case of a single-round retrospective survey, at least a partial life history going back to the time before the project was implemented is necessary (as in the Brazil project described above). Even in the case of migration, the effects may differ considerably in the long run from the short run. There is, of course, the alternative of a large experimental design study covering many households in many areas or communities (some with and some without the projects), but the cost of this is likely to be several times higher.

It is clear from the five case studies, as well as the comparative methodological assessments in this chapter, that there are significant lessons for policy-makers who are involved in deciding upon or designing similar projects. A major complicating factor has always been that one development project is rarely carried out in isolation, but rather in conjunction with other projects, including infrastructure changes. An important goal for social scientists undertaking population impact analyses is to attempt to identify the separate effects of the development project on those whose lives are changed. Such information, from past project analyses, could be presented to development planners[42] and used to estimate the expected population impact of similar pro-

jects still in the planning stages. If the impact is expected to be unfavourable, changes in project implementation may be possible to ameliorate the negative consequences.[43] For development planners in countries which have specific population policies and goals, impact analysis may be able to identify economic development projects which are undermining or in conflict with population goals. In such countries, population impact analysis at the project level also provides information which can influence the choice of economic development projects, at least at the margin. For example, some development projects might be equivalent in terms of settling economic goals but one may also lead to lower fertility or mortality or a better population distribution and thus be preferred.

Impact analysis is thus a subset of policy analysis. Policy analysis is based on expectations about the effects of particular policies, usually at the macro level. Project impact analysis provides information at the micro (individual/household) or community level, which can be considered a useful input into policy analysis. None of the case studies presented here has strong enough findings to base broad policies on at this point, but they do give clues to problem areas which should be investigated further and to the additional kinds of information which should be collected. For example, the Brazilian case points out many errors of planning and implementation which led to project "failures" in terms of meeting specific government goals. The chapter also discusses the genesis of a class structure which resulted from an inflexible land allocation policy and other issues which should be taken into account as the Brazilian government seeks to improve upon the approach in Rondônia.

It is unfortunate that most research on the demographic impact of development projects has not been made easily available to policy-makers. Part of the problem results from the academic orientation of population research: to be published becomes more important than to be understood, and the more sophisticated or arcane the work, the greater the likelihood of publication. This has resulted in many journals becoming more and more specialized and less and less useful for the planner. Thus, though research methods (especially statistical procedures) are becoming more advanced, the result has been a further rarification of the field—a larger gap between the academic or specialists' world and the "real" world of development planning. As we develop and improve our methods and our ability to identify "real" relationships and causality, we should also develop our abilities to better communicate our findings to development planners. Only in this way can research have the potential for improving the human condition, alleviating poverty, and reducing population problems.

In conclusion, despite their theoretical and methodological weaknesses, the case studies presented here do provide information of value to policy-makers. As population impact analysis continues, and methodological guidelines are further developed, it can play a useful role in policy decisions.

POSTLOGUE

During the evolution of the field studies and this monograph, all the authors involved in the preparation of this book have come to recognize that population impact analysis is very complex. Therefore, while very small scale and inexpensive pilot studies (such as the five here, whose budgets were generally in the $10,000 to $30,000 range) can collect useful data and lead to provocative hypotheses, they cannot yield unambiguous findings. The project reported on herein which collected the most data and offers the best possibilities for further analyses with useful policy implications had earlier received other support from several international organizations. We therefore urge that greater resources be allocated to do the job better—viz., at the outset of a development project allocate sufficient funds to collect baseline data on a probability sample comprising significant numbers of both households and communities in *both* project-impact and control areas, to be followed some five to ten years later by a separate survey (perhaps a partial panel). A survey in only direct project impact areas is not sufficient. The alternative is a large-scale, single-round, post facto survey with intensive, retrospective data collection in a number of both project and control areas to inquire about conditions prior to the project as well as at the time of interview. This has the advantage of not requiring a long funding commitment over time but may (a) encounter memory recall problems of respondents, and (b) suffer distortions because of changes that have occurred in the population composition of the project impact area or in socioeconomic conditions in the area resulting form factors *other than* the project.

The five case studies and other survey experience of the editors suggest many other, more specific characteristics of a desirable survey system for collecting data for a meaningful population impact analysis, besides ensuring some mechanism for measuring the demographic and economic conditions of the population in the project area before and after the project to achieve statistical homogeneity. These include designing a careful multipurpose household survey instrument, collecting information at the community as well as the household level, using probability sampling methods to select households, careful training of interviewers, planning enough time for collection of data in the field (to avoid rushing and its effects on data quality), allocating sufficient project time and funds for both data processing and analysis,[44] using both simple tabular and more complex multivariate techniques to separate out project effects from the effects of other concommitant changes, and presentation of the findings to government officials in a clear and concise manner.

Given the funds involved in development projects, allocating even a fraction of one per cent of the total to population impact analysis could permit potentially very useful data collection for population impact analysis.[45] Not only better data collection but better analytical approaches are needed to develop improved methodologies for assessing the population impact of development projects. A manual that thoroughly explores these issues and develops specific and detailed guidelines would appear a most worthwhile undertaking. Such a manual could ensure not only better but more comparable design of approaches, which could contribute towards the development of improved theoretical approaches as well. In the absence of such a manual investigators will continue to grope in the twilight, based on hunch and their own inevitably limited experience.

NOTES

Chapter Seven

1. For example: Little, I.M.D. and S.A. Mirlees, *Project Appraisal and Planning for Developing Countries* (New York: Basic Books, 1974); OECD, *Manual of Industrial Project Analysis for Developing Countries, Vol. II, Social Cost-Benefit Analysis* (Paris: OECD, 1968); OECD, *Evaluating Social Projects in Developing Countries* (Paris: OECD, 1980); UNIDO, *Guidelines for Project Evaluation* (Geneva: UNIDO, 1972).
2. For example: Cernea, Michael M., *Measuring Project Impact: Monitoring and Evaluation in the PIDER Rural Development—Mexico.* World Bank Staff Working Paper No. 332 (Washington, D.C.: World Bank, 1979); Bell, Clive, Peter Hazell and Roger Slade, *Project Evaluation in Regional Perspective: A Study of an Irrigation Project in Northwest Malaysia* (Baltimore: Johns Hopkins University Press, 1982); and Casley, Dennis J. and Denis A. Lury, *Monitoring and Evaluation of Agriculture and Rural Development Project* (Baltimore: Johns Hopkins University Press, 1982).
3. United Nations, *Manual IX. Methods of Measuring the Effects of Family Planning Programmes on Fertility* (New York: United Nations, 1980).
4. Johnston, Bruce F. and William C. Clark, *Redesigning Rural Development: Strategic Perspective* (Baltimore: Johns Hopkins University Press, 1982).
5. Sweden. *Evaluating the Evaluation Game* (Stockholm: Swedish Agency for Research Cooperation with Developing Countries, 1983).
6. Bunnag, A., S. Suwannodom, N. Chongwatana and M. Cha-um-pluk, *Migration in Relation to Rural Development: Self-Help Land Settlement in Thailand* (Bangkok: Institute of Population Studies, Chulalongkorn University, 1981).
7. Ibid.
8. Martine, George, "Colonization in Rondônia: Continuities and Perspectives." In Peter Peek and Guy Standing (eds.), *State Policies and Migration: Studies in Latin America and the Caribbean* (London and Canberra: Croom Helm, for the International Labour Office, 1982).
9. Kloos, Helmut, "Farm Labour Migrations in the Awash Valley of Ethiopia." *International Migration Review,* v. 16, n. 1, 1982, pp 133-168.
10. World Bank, "Measuring the Demographic Impact of Bank Projects." A report on a workshop sponsored by the Population and Human Services Division, The World Bank, April 24-25, 1979, Washington, D.C., pp 10-10.
11. Cf., for example, Easterlin in Bulatao, Rudolfo A. and Ronald D. Lee, eds., *Determinants of Fertility in Developing Countries* (Academic Press, 1983).
12. See: Bilsborrow, Richard E., "Priority Areas for Future Research on Demographic-Economic Interrelationships." In *Population and Development Modelling,* Population Studies No. 73, Proceedings of UN/UNFPA Expert Group Meeting, Geneva, 24-28 September 1979 (New York: United Nations, 1981); Bulatao, R.A. and R.D. Lee, eds., *Determinants of Fertility;* and Faroq, Ghazi and George Simmons, eds., *The Economics of Fertility Behaviour in Developing Countries: Research and Policy Issues* (Geneva: International Labour Office, 1984).
13. See Molyneaux, John and Richard Bilsborrow., "The Determinants of Rural Fertility in Developing Countries." Carolina Population Center Working Paper No. 27, Chapel Hill, NC, 1983, and references cited therein.
14. Broader issues of experimental design are discussed in, for example: Fisher, R., *The Design of Experiments,* 6th Edition (London: Oliver and Boyd, 1953); Selltiz, C., M. Jahoda, M. Deutsch and S.W. Cook., *Research Methods in Social Relations* (New York: Holt, Rinehart and Winston; London: Methuen, 1959); and Campbell, Donald and J.C. Stanley., *Experimental and Quasi-experimental Designs for Research* (Chicago: Rand McNally, 1963). See also Herrin, Alejandro H., "A Research Strategy for Analyzing the Demographic Impact of Rural Development Projects: the Case of Rural Electrification in Misamis Oriental, Philippines." Discussion paper prepared for the International Population/Development Consortium Workshop, Carolina Population Center, University of North Carolina, Chapel Hill, NC, September 11-20, 1979.
15. Of course, in an area undergoing substantial migration, the population itself may be

quite different in time t from time o. And over time individuals may be stationary but form households (by marriage) or dissolve them. We are grateful to Henriques for this observation.

16. Bilsborrow, Richard E., Arjun Adlakha, Annie Cross, Dennis Chao and M. Nizammudin, *Analyzing the Determinants of Fertility: A Suggested Approach for Data Collection.* Laboratories for Population Statistics Manual Series No. 9. (Chapel Hill, NC: University of North Carolina, 1982).
17. Bearing in mind that for at least one project (Brazil), the original data collection effort was not primarily to assess the demographic effects of the project but the living conditions of the settlers.
18. They were not perfect controls, however. The "non-electrified" town, Villa Gomez, had electricity at night even prior to the electrification of El Penon.
19. Kish, Leslie, *Survey Sampling.* (New York: John Wiley & Sons, 1965).
20. For example, Brewer, K.R.W., "The Analytical Use of Unequal Probability Samples: A Case Study." Paper presented at the 43rd. Session of the International Statistical Institute, Buenos Aires, Argentina, November 30-December 11, 1981, p. 11.
21. The latter is hardly atypical. Only a small fraction of the migration survey data sets reviewed for the ILO book are based on probability samples. See Bilsborrow, R.E., *Surveys of Internal Migration in Low-Income Countries: Issues of Survey and Sample Design, Section II.A* (Geneva: International Labour Office, 1981), and Bilsborrow, R.E., A. Oberai and G. Standing., *Internal Migration in Low-Income Countries: Guidelines for Survey and Questionnaire Design* (London: Croom-Helm, for the International Labour Office, 1984).
22. Bilsborrow, R.E., "Priority Areas for Future Research," and Bilsborrow, R.E., "Population-Development Research: A Methodological Assessment." Unpublished paper submitted to the United Nations Fund for Population Activities, 1982, and Bilsborrow, R.E., "Collecting Community Data for Fertility Analysis." Paper presented at the Seminar of International Statistical Institute/World Fertility Survey on the Collection and Analysis of Data on Community and Institutional Factors, London, June 20-23, 1983. Forthcoming in Casterline, ed, (1985).
23. Cf, Casterline, John ed., *The Collection and Analysis of Community Data* (Voorburg: International Statistical Institute, 1985).
24. Freedman, Ronald, "Community Level Data in Fertility Surveys." *World Fertility Survey Occasional Papers,* No. 8. (London: World Fertility Survey, 1974); Bilsborrow, R.E. "Collecting Community Data."; World Bank, "Measuring the Demographic Impact"; and Casterline, ed., 1985.
25. Freedman, R., "Community Level Data," and Bilsborrow, et al., *Analyzing the Determinants.*
26. Bilsborrow, R.E., *Surveys of Internal Migration.*
27. Some limited community or area-level information was informally collected by Henriques in Brazil (not discussed in this volume).
28. Bilsborrow, R.E., et al., *Analyzing the Determinants.*
29. Note our use of $X_0(P)$, even though the settlers resided in *other,* quasi-control areas prior to migrating to the project area.
30. See, for example: Bilsborrow, R.E., et al., *Surveys of Internal Migration,* and references therein.
31. Bilsborrow, R.E., et al., *Analyzing the Determinants.*
32. Bilsborrow, R.E. et al., *Surveys of Internal Migration.*
33. Chayovan, Napaporn and John Knodel, "Improving the Collection of Village-Level Data—An Experience from Thailand." Paper presented at the World Fertility Survey International Statistical Institute Seminar on Collection and Analysis of Data on Community and Institutional Factors, London, June 20-23, 1983.
34. Bilsborrow, R.E., "Population-Development Research."
35. Associated with each pre-test, of course, should be a written report describing procedures, providing tabulations for data collected, and indicating problems encountered and changes adopted. This would assist in both setting a good example and providing information useful for future questionnaire design in the country.
36. This may have been a factor in his dropping original multiple regression results from the chapter rather than revising them, as we had suggested in correspondence.
37. A peculiarity in Colombia was that data for the years 1979 and 1980 were inexplicably "combined in data processing" (see Tables 1 and 2, Chapter 3). This created a statistical outlier, which undoubtedly biased the results.

38. It would have been very interesting to see information organized in this way in the other case studies.
39. This may be, at least in part, because they are only cross-sectional, and Herrin had earlier noted (1979) the desirability of $[X_t(P)-X_0(P)]$ and $[X_tC-X_0(C)]$, which is all aggregated cross-area tabulations show.
40. See the papers presented at the 1983 World Fertility Survey London Conference by Blalock, Hermalin, Bilsborrow, and others (brought together in Casterline, ed. *The Collection and Analysis.*
41. King, Timothy. "Measuring the Demographic Consequences of Development Programs and Projects: A Background Note for the Bank Workshop, April 24-25." Paper written for a workshop sponsored by the Population and Human Resources Division, World Bank, Washington, D.C., April 24-25, 1979.
42. A useful procedure is to prepare two documents on the population impact project: (1) a complete technical write-up for social scientists and government technicians, and (2) a one or two-page, non-technical "executive summary" of the project, focusing on its policy implications, for high government officials.
43. An interesting example comes to mind. In the case of the rural electrification project in the Philippines (and in contrast to Colombia), the government decided that the beneficiaries should pay fully for the installation costs of electricity, and provided funds which families could borrow. During the subsequent six to fifteen month repayment period, families appeared especially aware of the opportunity costs of having another child or of permitting their young children to marry. This seemed to hasten the adoption of family planning, which, once begun, tended to be continued. Requiring families to pay for the projects they benefit from, and providing the funds for them to borrow, may thus be a useful way to maximize the demographic impact, as well as economize on scarce government funds.
44. Bilsborrow (1974) noted the omnipresent concentration of resources on data collection rather than analysis years ago. The problem has, if anything, become worse. (See Bilsborrow, R.E., *The Preparation of an Inventory of Demographic Data for Social and Economic Planning,* Manual 4. Chapel Hill, NC: Laboratories for Population Statistics.)
45. Multipurpose survey data could be used to better access the *economic* effects of the development project as well.

APPENDIX

FORMAT FOR REPORT ON ASSESSING THE DEMOGRAPHIC IMPACT OF A DEVELOPMENT PROJECT[1]

1. **Introduction**

   Purpose(s) of the research project; relevant antecedents (sources of funding and other support, names of institution and personnel in project, and duration of project, on title page, in an initial footnote, or in an Annex).

2. **The development policy under investigation**

   Major purpose(s) of the development project (e.g., irrigation, road construction, electrification, colonization, construction of schools). Extent of provision of related facilities and dates of becoming available in community; whether accessibility is general or limited to particular sub-areas or population subgroups. *Cost, if any. If relevant, use by groups outside the community and their cost.

3. **Theoretical approach and hypotheses to be tested**

   Underlying theoretical model or approach. Statement of particular hypotheses and *a priori* expectations re. effects on migration, fertility, health and mortality, economic welfare, etc.

4. **Data collection methodology**

   Area(s) and population(s) covered; domains of analysis; planned vs. actual sample size and composition of sample; judgment or probability sample; stratification; stages in sample if more than one.

   Control group population, if any. Characteristics. Sample selection procedures. Comparisons with project sample population.

   Questionnaire content and justification of topic coverage (relation to purpose of project). Identification of desired respondent, whether proxies/substitutes permitted, and number of callbacks used.

   Whether had pre-test(s) of questionnaire or field procedures/organization: size, what was learned, and changes made in survey questionnaires or field procedures. Duration of training for interviewers/supervisors for definitive fieldwork. Field procedures: size of field team and ratio of supervisors to interviewers; logistical aspects (transportation, lodging, etc.). Any special aspects of training.

Repeat four paragraphs above for community samples, questionnaire, and data collection procedures.

Survey organization; whether used PERT charts, planned and actual timetable of survey project activities by week.

Actual sample obtained. Extent of non-response, and particular areas or types of respondents where high. Major reasons for non-response (refusals, appropriate respondent not available, dwelling vacant, inaccessible, not on map, weather, ran out of money, etc.). Difficulties encountered in fieldwork and solutions adopted. Extent of co-operation from individuals and community respondents and how obtained. Implications for analysis and interpretation of results.

*Analysis of non-response by area, type of respondent (age, sex, SES level, etc.), type of interviewer, etc. Expected biases resulting.

5. **Data processing**

Procedures, volume of work, staff involved. Time it took for coding and hand editing to enter data on cards or disk/tape and for developing necessary computer programmes (or adapting packaged programmes). Preparation of complete files for storage/analysis and working files. Problems encountered and solutions adopted at each stage.

6. **Composition of population**

Description of population studied (in the actual sample): location, age, sex, education, land ownership, occupation, migrant status, income, etc. (tabulations).

*Comments on extent to which actual sample differs from population in general in the survey area (departures from representativity), and reasons.

*Description of sample communities and extent to which representative.

7. **Statistical estimation methodology**

Use of descriptive and tabular vs. multivariate analysis.

Definition of variables. Proxy and other variables used in the analysis.

*Use of single-equation vs. multi-equation analysis methods (including path models and simultaneous equation models). Use of multi-level analysis.

*Special problems with the data, variable definitions, or model, and solutions adopted (e.g., use of probit or logit model where dependent variable is dichotomous).

8. **Empirical results**

Presentation in tables and text. Include applicable R^2, chi^2, t-tests, etc., and significant levels, including sample sizes on which based.

9. **Policy implications**

Discussion of interrelationships of the development project with other government policies.

Implications for local (community), state, and national policies re direct government intervention programs (e.g., via expenditure programs) and motivation, subsidy, and credit operations to stimulate changes in household behaviour or in private sector activities.

Linkages of research project and staff to government planning ministries or other agencies. Plans and problems in communicating results. Plans for country dissemination of results and publications in local language.

10. **Conclusions**

Limitations of the analysis and caveats. Recommendations regarding future project to estimate the demographic impact of development projects in the country (methodological re data collection, measurement of variables, and estimation of project effects).

Annexes: — Individual/household questionnaire
— Community questionnaire/areal data obtained
— Project timetable (from signing contract to publication of results)
— Budget (including functional breakdown)
— Codebooks for questionnaire(s)

---

[1]Suggested format for field investigators to provide additional information to UNC/CPC, mailed to Consortium members, on August 7, 1981. This format was developed by the editors to maximize our ability to compare the methodological aspects of the five field projects, and to point towards a more general framework for future evaluations.

NOTE: Items with asterisks (*) are strictly optional and may not be relevant in a particular project.

ADDENDUM

THE INTERNATIONAL CONSORTIUM OF RESEARCH CENTERS: CONCEPT AND EVOLUTION

BACKGROUND AND RATIONALE

The International Consortium of Research Centers for the Study of the Population Impact of Development Projects was initiated in the spring of 1979 by representatives of the North Carolina Population Center (CPC) of the University of North Carolina (UNC), and the Policy and Evaluation Division of the United Nations Fund for Population Activities (UNFPA), and the Population Division of the Rockefeller Foundation interested in the benefits of international co-operation among population research centres. The Consortium was designed as a forum for discussion and collaborative research concerning the population impact of development projects whose primary goals were not population related. It was conceived as an embodiment of the principle of Technical Co-operation among Developing Countries (TCDC), since the constitutent centres would jointly plan their research projects so as to provide a cumulative experience in population impact analysis.

The Consortium consisted of six member institutions (see Introduction). The Carolina Population Center served as secretariat and headquarters for coordination and data analysis. Each of the other five institutions was represented by a Principal Investigator who developed and conducted a study on the demographic impacts of a specific development project in his or her country.

Mechanisms through which Consortium members learned from each other included a preliminary workshop for joint design of projects; circulation of progress reports, publications, and other information during the fieldwork period; a follow-up workshop at which principal investigators discussed problems encountered, analytic methods used, and preliminary findings; and subsequent circulation by mail of comments and suggestions regarding final project reports as well as the introductory and concluding chapters of this book.

CPC first proposed the idea of a Consortium to the UNFPA in the summer of 1978. After the Bucharest Conference, in 1974, it had become a common belief that socioeconomic development could in itself slow population growth in developing countries. But government planners lacked concrete knowledge of how their socioeconomic planning would affect population. In fact, it had become clear that in some countries development projects which were planned to alleviate social problems actually exacerbated them by leading to increased fertility or intensified maldistribution of population. With these factors in mind, it was felt that empirical studies on the demographic impact of common types

of development projects in different settings could contribute to a better understanding of development-population interrelationships.

SUMMARY OF OPERATIONAL ACTIVITIES

The Consortium held its first workshop at the Carolina Population Center in Chapel Hill on September 11-20, 1979. The goal of the workshop was to improve the five research proposals and attempt to establish greater comparability among the projects. Each investigator brought to the meeting a proposal dealing with the demographic impact of a particular development project in his or her country. The participants exchanged views on topics relevant to all five studies, such as research designs, conceptual approaches, and possible data collection or analysis problems.

After the first workshop, the investigators conducted surveys in their respective countries, and began processing and analyzing their data. None of the projects was able to comply with its original schedule due to unforeseen problems which arose during the research. Most problems occurred during actual field work. For example, ter Wengel was forced to postpone the pre-test of his questionnaire in his two villages for nearly six months due to two natural disasters, an earthquake and a flood, which made the villages inaccessible. Henriques changed jobs during the project period; her new responsibilities necessitated a re-scheduling of her survey. In addition, she conducted the survey under very difficult conditions in the Amazon jungle and was forced to change considerably the original field survey plan (see Chapter 6). Uyanga had problems with data coding, processing, and analysis because of a breakdown in the computer system at the University of Lagos, there being no computing facilities at the University of Calabar. The projects of Herrin and Pramote also experienced delays, albeit smaller ones, particularly in data processing.

The Consortium held its second conference at CPC on June 21-30, 1981, during which members discussed their field research, compared research problems and preliminary findings, and utilized CPC's computing facilities for analysis. They were joined by a number of CPC faculty, as well as representatives of funding agencies and the United Nations. An important focus of the conference was on the policy implications of the research (and of population-development research in general), and therefore on problems of inferring policy implications and strategies for presenting the results to policy-makers. It was decided that the Consortium was such a unique arrangement of complementary research and that the topic was so important that an edited volume on the demographic impact of development projects, with a chapter on each project as well as an introduction and a concluding chapter on methodological issues and lessons, would be an additional desirable outcome of the Consortium. The present volume is the result of that recommendation.

EVALUATION OF THE CONSORTIUM

In order to inform those who may be planning for similar collaborative/co-operative research programmes, we include here a brief evaluation of the

strengths and weaknesses of the Consortium, as well as suggestions for similar future arrangements. The Consortium was established as a forum for Technical Co-operation among Developing Countries (TCDC) to improve research by allowing individual indigenous researchers and institutions to benefit from each others' knowledge and experience. The Consortium concept was an innovative approach to TCDC; both its accomplishments and its problems are related to its "pioneer" status.

Successes

Most importantlly, the Consortium led to communication and sharing, both intellectually and socially, among scholars from different countries interested in population and development research. The field investigators represented not only diverse cultures, but also different academic disciplines and research experiences. Though all were in some way associated with universities in their countries, some worked primarily in research institutes and one in a government statistical agency. These diverse perspectives led to rich and lively discussions of goals, methods, and findings, both regarding the individual research projects and population-development research in general. The participation of UNC faculty, similarly with diverse backgrounds, gave additional impetus to interdisciplinary scholarly exchange. The results included improved research designs and better utilization of research methods in all five field studies, increased awareness of important issues in demographic-economic research, and the investigation of ideas upon which a more general approach to studying the interaction between population and socioeconomic change may be built.

The relationships established among Consortium members benefitted everyone. As each researcher continues his or her work, the result should be better research. In this sense the Consortium can be considered successful, illustrating the value of international collaboration in research. Such arrangements should continue as they can be an effective and relatively inexpensive way to enhance both the technical quality and policy relevance of research on population-development interrelationships in Third World settings. To aid in planning and establishing such future co-ordinated or collaborative research, problems encountered and lessons learned during the three-year period of this Consortium are discussed briefly below. (The Consortium Final Report contains further details.)

Problems Encountered and Lessons Learned

Many of the minor problems which arose during the project resulted from the experimental nature of the Consortium. As there was no precedent in establishing such a relationship among individuals and institutions conducting research projects on similar topics in different countries, both the Consortium members in the field and those at CPC did not know what to expect. The notion of "opening up" research to others from different countries and backgrounds was not always found easy to implement. In the beginning, there was defensiveness in the way investigators presented research plans, perhaps exacerbated

by the varying and complex institutional arrangements among the principal investigators, CPC, and the funding agencies. Investigators were unsure of their responsibilities to other Consortium members, CPC, and their funding agency. This led to some early misunderstandings as well as to problems for the editors in obtaining revisions of final reports from some of the researchers. These problems could have been greatly reduced if responsbilities had been clear from the start.

Another difficulty was that the principle of technical co-operation among developing countries (TCDC), upon which the Consortium was based, was weakened by (a) the necessity of holding both workshops in Chapel Hill, and (b) the fact that CPC did not directly collaborate in any of the projects or present a project of its own for discussion. Regarding (a), while computer and research facilities at CPC were an important asset, since some investigators had very limited facilities at their own institution, it still would have been preferable to hold a workshop at another member institute. The original intention of the Consortium was to have three meetings: one to finalize research plans, one during data analysis, and the last to present research findings. While CPC could perhaps best host the second meeting (during the data analysis phase), because of its research facilities, the other meetings could well have been held elsewhere.*

A related issue (b) was the difficulty of maintaining a true peer relationship between the investigators and CPC faculty. Because CPC did not have an ongoing study on the demographic impact of a development project to present, CPC faculty involved in the Consortium sometimes appeared to be evaluating the research of others rather than sharing experiences.

Other problems encountered included unavoidable events, such as natural disasters in Brazil and Colombia, increasing prices worldwide (which caused problems for not only the field researchers, who faced higher costs than budgeted, but also CPC, since international airfares rose considerably), and delays in the international postal service.

Only two field investigators took advantage of the computer facilities at CPC to conduct their data analysis, though all had earlier indicated an interest in carrying out some analysis at CPC. After receipt of the draft reports, and in the course of subsequent responses by investigators to detailed queries of the editors, it was clear that each project could have benefited significantly from further statistical analysis. Indeed, lack of adequate computer facilities was cited by four of the five researchers as a significant impediment to their analysis. It therefore would have been desirable for several of the investigators to have spent more time in Chapel Hill for this purpose, but funds were not available. For example, if they had been able to remain for six to eight weeks instead of ten days, they could have greatly improved their data analysis. CPC faculty would

---

*Increased costs of travel and maintenance eventually precluded a third meeting, which would have been invaluable for improving the research reports and further discussion of results.

also have benefited by becoming more involved in the "real-world" problems of the field investigators. It is clear that in future arrangements, it will be desirable to budget for longer periods of data analysis.

It would also have been better to have had more direct communication among Consortium members. While several members briefly visited the Philippines and Thailand institutions in connection with the IUSSP meeting in Manila, in December 1981, it would have improved the Consortium if the field investigators had been able to visit each others' site(s) and if CPC members also could have visited some field sites. Clearly this is related to the level of collaboration embodied in the Consortium projects, and to the funding for international travel.

As for the longer-run future of this particular International Consortium, at least one subsequent research project has been developed involving collaboration between a field investigator and CPC. Several other possible collaborative projects have been discussed, and two investigators indicated an interest in coming to Chapel Hill for a longer period to do further statistical analysis. Indeed, all five collected data at very low cost, data which *should* be subjected to further analysis. There is only a marginal cost in conducting further analyses, which could multiply several times the quantity and quality of the empirical findings. Follow-up surveys in several of the field sites could also greatly expand the analytical possibilities (see also Chapter 7 above).

The experience acquired and relationships established during the implementation of the five Consortium projects provide a foundation for continuation of collaborative research on the population impact of development projects and on other population-development interactions. The Carolina Population Center is actively encouraging further collaboration.

United Nations Fund for Population Activities
220 East 42nd St., New York, N.Y. 10017